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DEPARTMENT OF COMMERCE AND INDUSTRIES

DIVISION OF FISHERIES

INVESTIGATIONAL REPORT No. 34

THE CAPE FUR SEAL

(*Arctocephalus pusillus*)

Distribution, Abundance and Feeding Habits off the South Western Coast of the Cape Province

BY

R. W. RAND

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I. Summary.

1. This report is part of a general series dealing with the biology of the Cape Fur Seal, *Arctocephalus pusillus*, and primarily concerns its distribution, abundance and feeding habits in a limited area off the West coast of the Cape Province. During 1954, 1955 and 1956, seals were studied over an area of two hundred miles of coast-line between Lambert's Bay and Dyer Island, and information was gathered about their behaviour at sea. To these data are added others obtained, for instance, from the inspection of aerial photographs of herds residing within the study-area, and from observation of marked animals moving to and from the land.

2. Male seals are much larger than females, the former reaching a body-weight of from 450 to 800 lb., the latter fluctuating between 200 and 300 lb. Physiological changes affect the weight of the male more than that of the female. The heaviest weight of the male is acquired shortly before fasting for two months in the summer (rut). Young seals are seldom heavier than 100 lb. The female seal has a period of gestation of 361 days which may be longer in those mating for the first time. Suckling of a pup from a previous pregnancy occurs during a subsequent one and lasts as long as ten months.

3. Seals are widely scattered throughout inshore waters and extend up to 100 miles from the land. Young animals tend to stay in protected bays or near their birth-places; older seals journey far from the land and are seen in the deep-sea trawling grounds.

4. Seals are seldom found in large numbers at sea, small groups composed of two or three animals being most frequently encountered. Larger concentrations of seals occur only when prey is particularly abundant. A distinct seasonal change in abundance at sea hinges upon the exodus of yearling seals from their rookeries during the late winter.

5. From estimates of numbers on land, it is believed that the total number of seals of all ages inhabiting Cape rookeries* does not exceed 50,000. One third of these are young animals. Winter sealing drastically reduces this total each year.

6. Seals catch individual prey, surfacing to handle large organisms but otherwise ingesting small ones under the water. Feeding journeys of five to ten days duration are followed by a return to land for nearly the same length of time. Feeding activities are influenced by the weather, proximity of food and physiological needs. Frequent rests are taken between meals. Feeding occurs throughout the day. The seals are surface-feeders, seldom pursuing their prey to great depths. It is unlikely that the stomach is filled every day. Digestion is slow and long sojourns on land are needed to clear the alimentary canal.

7. Food consists of fish, cephalopods and crustaceans. On the basis of frequency of occurrence, the ratio of food items in 245 stomachs of seals from the south western Cape coast was roughly 50 per cent fish, 37 per cent cephalopods and 13 per cent crustaceans, but on the basis of volume, the ratio was roughly 70 per cent fish, 20 per cent cephalopods and 2 per cent crustaceans with about 8 per cent of miscellaneous matter. Owing to the differential digestion of the soft-bodied preys, these volumetric ratios over-emphasise the importance of fish. A maximum amount of 25 lb. fish or 30 lb. cephalopods may be taken at one meal by adult seals. The normal intake of all foods is from 2 lb. to 4 lb. per meal.

8. Based upon the examination of 245 stomachs of seals captured off the south western Cape coast, the most numerous prey were squid and maasbankers. Small shoal fish were taken more often than large ones, and the free-swimming squid more than the benthic octopuses.

9. Seals can be kept in captivity in good health on a daily allowance of 5 to 15 lb. of fish.

10. Because of its diverse tastes and differences in the style of hunting, the seal does not seriously compete for food with other marine animals. Although near the top of the food-chain, the seal takes large and small prey indiscriminately.

11. The remarkable growth of our commercial fisheries obscures any impact that the seals may be having on resources of small fish. It is considered unlikely that the seals compete seriously with modern fishing techniques (electronic shoal-location and the use of lampara nets), nor do they affect the commercial catch to any great extent. Where fishing grounds are artificially depleted, the

* The term " Cape rookeries " is intended to cover those islands and rocks on which seals congregate, viz., Elephant Rock, Jacob's Reef, Robbesteen, Duikerklip, Seal Island, Geyser Rock and Quoin Rock.

seal as a better organised predator, is able to compensate for lack of prey by adjusting its diet and hunting elsewhere.

12. A flourishing sealing industry effectively controls the numbers of seals by means of intensive winter catches. So far the annual take of seals has prevented any large-scale recruitment to the adult classes with the result that increases in numbers have been relative rather than absolute, i.e. confined to part of an existing herd establishing a new rookery elsewhere. There is no special need to control the population* on any basis other than the usual commercial one of annual killing for profit.

2. Introduction.

The Cape fur seal has been exploited by the government for over 70 years but private hunting has taken place for a much greater period. Little success, however, attended these efforts until hunting was intensified in 1950. The annual catch of seals has trebled since 1945, a steady exploitation by private enterprise maintaining catches which exceed those from official sources (Table 1). Legislation controlling the take of seal skins aims at conserving the animals so that a sizeable harvest can be sustained at a slightly increased rate year after year. The industry is mainly concerned with the export of raw pelts and has neglected the by-products.

TABLE 1.—Number of Winter Pelts taken 1950–55.

Year.	Union Government.	Private Enterprise.	Total.
1950.....	10,986	16,101	27,087
1951.....	13,766	19,427	33,193
1952.....	11,741	18,542	30,283
1953.....	10,882	16,041	26,923
1954.....	12,550	22,407	35,957
1955.....	11,186	26,131	37,317

Seals are marine mammals, at home on land and in the sea; they perform no special seasonal migration but are found throughout the year at islands or on isolated parts of the mainland. Many years ago seal rookeries lay outside the sphere of normal fishing activities. Indeed, until recent years, only the seals of False Bay have attracted attention owing to their proximity to line-fishing grounds. Scant notice was taken of larger herds elsewhere.

Since 1945, however, a west coast inshore pelagic fishery has arisen and the increased traffic of boats and the development of new harbours have brought fishermen into almost daily contact with the seals. The phenomenal growth of the pilchard/maasbanker industry, the imposition of necessary control measures and many unexplained fluctuations in catches of these fish, have all forced fishermen to consider other means of augmenting their take from the sea. It was inevitable that a measure of relief was sought by questioning the presence of seals who were pictured as dangerous competitors for edible fish.

During 1953 the government was repeatedly requested to remove seals from the economy of the coast, it being claimed that these animals consumed more fish of commercial value than were landed by the entire fishing industry. It was contended that their removal would allow the relaxation of certain control measures thought to be restricting the growth of that industry. In particular, it was alleged that the amount of fish taken by seals would be immediately available for new factories and additional boats provided the predators were removed. This was a basic allegation that has never been seriously challenged. It was a stepping-stone for many contentious and exaggerated statements about the economic position of the seals. In fact, the controversy gave the present investigation a priority over all other management projects although the research organisation was ill-prepared for the work.

In mid-1954, at the instigation of the Minister of Economic Affairs, the Guano Islands Administration of the Department of Commerce and Industries began a study of the feeding-habits of seals and sea-birds off the western Cape Province [see Section 3 (i)]. The organisation of this research was taken over by the Division of Fisheries a few months later.

The principal mandate carried by the investigation is implicit in a statement made in Parliament that " this House having heard the statement of the Minister of Economic Affairs decide to leave the matter in his hands for further study and investigation of the effects on sea-food resources of fish-eating birds and animals by the Divisions of Fisheries and Guano Islands, respectively." An amended motion asked that the government

* The recent imposition of catch quotas (winter, 1958), unrelated to the actual strength of the rookery populations, may necessitate a revision of control measures.

" consider whether it is necessary to take steps to destroy such birds and animals." (Senate Debates, 3rd June, 1954.)

The Guano Islands Administration seeks to manage seals and sea-birds on islands off the Union of South Africa and is essentially a commercial undertaking. Nevertheless, its primary function of exploitation for profit has deep-rooted conservational obligations. Seals respond well to protection on their breeding grounds. Management then becomes a compromise between the endeavour to seek increased production from growing numbers, and the fear that conservation will eventually produce stagnation through over-population in areas where the supplies of food are thought to be limited. Recognition of control is seemingly less evident in the sealing industry than in the guano trade, sealing operations reducing rather than stabilising numbers. But at all times any outside control of numbers of these animals is of immediate concern to this Administration.

Governmental management recognises that growth of the seal population depends upon basic sea-foods, but it exploits a class of seal (yearling-pup) that is virtually independent of natural prey. This class is fostered by animals feeding beyond the zone of the pelagic fisheries. In spite of their paucity in inshore areas, seals are part of the inter-related fauna of the coast. Their numbers pose common problems of predation which interest man. Today there are observers who claim that the three industries (guano collection, sealing and fishing) make irreconcilable demands upon each other. The feeding-habits survey was initiated without delay to expose trends in the economy of each of these three coastal industries.

3. Method of Study.

The compilation of data about the presence, numbers and food of seals at sea necessitated travelling over a wide area in search of the seals, noting their whereabouts and combining such sight records of live animals with the examination of those that were killed. The data are mainly the result of personal observations and hunting from small craft cruising regularly round the western Cape coast from mid-1954 until the end of 1956. Other relevant facts about the seals are drawn from a special log kept by officers of R.S. *Africana II* from April, 1950, until August, 1953, when on routine cruises off the West coast; from personal visits to seal rookeries with government or private sealing teams; from special investigations into the general biology of the animals; from the analysis of aerial photographs of various islands; from visits to the deep-sea trawling grounds; and from cruises to various oceanic islands during 1951/52. Some of these sources of information have obvious shortcomings, chiefly because they lack continuity and do not permit a proper seasonal study of such aspects as distribution and abundance over a wide area. The analysis of the more concentrated inshore work has suffered in the same way.

(i) Pelagic Studies, 1954–56.

In 1954 the *Malagas*, a patrol-boat of the Guano Islands Administration, and later in the same year the *Palinurus* and *Schipa*, both research vessels of the Division of Fisheries, were used to hunt and and observe seals off the coast. The *Palinurus* and *Malagas* are somewhat similar, fifty-foot, single-screw, fishing cutter-type vessels capable of cruising at eight knots. The *Schipa* is a larger boat, being a modified air-sea rescue motor-launch (B Class Fairmile) with a cruising speed of about twelve knots.

Owing to the limitations of the craft and the shortage of scientific personnel, the pelagic investigations were confined to the coast of the Cape Province from Lambert's Bay in the north and west, to Dyer Island in the south-east. Certain sea-birds were studied at the same time, work at sea being divided between their capture and that of seals.

Cruises originally commenced either at Saldanha Bay when exploring northwards across St. Helena Bay or at Cape Town when hunting round the Cape Peninsula through False Bay and thence towards Dyer Island. But in 1956 all searching started at Table Bay. Owing to frequent bad weather over most of the search areas, routes were planned with the object of reaching sheltered bays or harbours by nightfall. Hunting during the day-time would then take place for several days in an area between two anchorages, rather than at sea without the possibility of anchoring. No cruise throughout the entire investigation yielded more than two consecutive " hunting days ".

The greater speed of the *Schipa* enabled more extensive searching but the capture of seals was less successful owing to the lack of manoeuvrability and the difficulty of a silent approach as compared with the smaller boats. The elevated bridge of the *Schipa* gave better visibility than the other boats. With slightly larger craft and better navigational aids, the seals could readily be hunted in deep water farther from the land than was covered by the present investigation.

Voyages started on the 3rd June, 1954, and were terminated on the 21st December, 1956. Owing to preoccupation with other research duties, the patrol-boats could not be specially allocated for seal-hunting until 1956 when two cruises per month were scheduled for the year. The studies were interrupted during July and August of 1954 and 1955.

Year.	Number of cruises undertaken.	Number of hours hunting.
1954.....	14	216
1955.....	33	357
1956.....	27	546

The number of hours spent hunting the seals at sea varied from 216 to 546 annually. An average of 24 cruises per year was made from 1954 to 1956. Further details about the number of cruises in specific areas are given in Table 2 for both the patrol-boats and R.S. *Africana II.*

Over 1,300 seals were sighted at sea during the 1954–56 investigations; 428 of these animals were shot and believed killed, but only 245 were actually recovered. A monthly analysis of these figures is given in Table 3, and the principal areas in which the seals were obtained are shown in Table 4. The general direction of the routine cruises for the same period is plotted on the map of Plate I (in this plate, the cruises of the patrol-boats are shown as solid lines, those of R.S. *Africana II* as broken lines). The bulk of specimens came from the Cape Peninsula where the sheltered False Bay proved a rich and convenient collecting ground. The number of specimens finally procured does not necessarily bear any relation to a statistically desirable sample size but is merely the outcome of hunting under the circumstances of the investigation.

A harpoon-gun of Norwegian make (Kongsberg M52) and a 12-gauge, single-barrel (choke) shot-gun were essential parts of the hunting equipment. As the harpoon-gun could be operated only from a fixed forward position, the more flexible shot-gun was preferred and many animals were despatched with special SG, No. 1 or No. 3 cartridges. For snapshooting (and most firing was of this nature) the shot-gun was more dependable. Success in shooting depended on several factors, such as experience in handling the different weapons (accurate aiming on a heaving deck), preparedness for the unexpected appearance of seals alongside the ship, ability of the helmsman to guide the ship to a suitable position alongside the target, recognition of distant animals and silent approach to those lying on the surface of the sea. The dead seals were pulled alongside by means of long iron-hooks. Manhandling the larger animals taxed the strength of all members of the crew.

Seals were sometimes successfully retrieved after shooting from a dinghy while the parent craft lay some distance away. Pods of seals were approached silently and in this manner two animals were obtained from a group where otherwise all would scatter after the first shot. When cows and their yearling-pups were encountered, the dead female was occasionally used to lure the young animal to the hunters. This technique of shooting from a small boat was possible only in calm weather or when the seals were sufficiently concentrated to warrant the delay of manoeuvring a dinghy. In practice it was seldom used.

Seals exhale as they dive, partly emptying their lungs in order to reduce the effects of water pressure. Because of this, moving animals shot on the surface frequently sank and success lay in shooting at those asleep or relaxed in the water. If killed instantly, they floated long enough to be retrieved whereas others about to dive sank immediately. Animals shot in the head (often the only target presented) as they were about to surface, also sank rapidly with little hope of recovery. Furthermore, it was difficult to forecast the intention of seals swimming past the ship. Some would stop and hold themselves erect, gazing at the vessel, then dive and

surface again in its wake. Others simply disappeared. In these circumstances snapshooting was rarely worthwhile unless the ship could be brought around and the dead animals grappled without delay. On most occasions, there was no difficulty in killing a seal but recovering its carcass was a real problem.

When hauled abroad, seal carcases were immediately tagged with two similarly-numbered lead tags. Field notes recording the time, place and circumstances of the capture were made. Owing to the motion of the ship (even at anchor) seals could not be weighed accurately and the steel-yard weighings tried at first, were discontinued later. Whenever possible, carcases were dissected soon after recovery but this rarely happened during deep-water hunting. The stomach was removed intact, preserved in dilute formalin and stored in a cloth bag labelled with one of the original lead tags. When needed, special parts of a specimen such as its genital organs and skull, were preserved and labelled with the other lead tag.

All stomachs were taken to a laboratory on shore after each cruise. They were first weighed whole and again after separation of the gross contents. The volume of the contents was then calculated by the displacement of water in a graduated cylinder. By measuring the volume of the contents in this way, the various items could be cleaned and separated when poured out of the cylinder into a coloured enamel dish for subsequent sorting and identification.

Various discrepancies in calculations of volume were introduced by this method of handling the contents. Thus the amount of liquid and the disintegrated items could not always be reconciled with the sum of subsequent volumes of the various items. The inclusion of sea-water taken during the death-struggle of some animals, also caused unavoidable but slight errors in calculations of the true weight and volume of the stomach contents. These small deficiencies, however, do not detract materially from the quantitative results obtained.

Stomachs were not specially slit before preservation as it was found that sufficient preservative penetrated through the contracted oesophagus (which was severed through its attachment to the stomach). In only few cases was there incomplete preservation of the contents.

The sex of captured animals was verified by the abdominal position of the penis-opening in the male and the location of the vulva between the hind flippers of the female. Since the pups are mostly all born during a short summer season, one can infer that the whole herd is divided into year classes. The younger animals may be distinguished by external criteria such as size and colour of the coat but these differences are not so marked in older animals and it becomes necessary to classify all small seals as sub-adults of either sex, and larger ones as bulls or cows, the latter being easily recognised in the water by the small head and neck and lighter colour of the body. Further age identification was made by examining teeth and skull and estimating the extent of closure of the sutures or, in the case of the female, by inspecting the condition of the genital organs (Rand, 1955*a*). Such approximate estimates of age were considered sufficient for purposes of the feeding-habits studies.

The pelagic studies of 1954—56 dealt essentially with specimen collecting. The urgent need to obtain specimens often militated against circumstances when feeding habits might have been studied more leisurely. Cruising allowed no reconciliation between the capture of specimens and detailed studies of their feeding behaviour. The effect of shooting and the arrival of the boat among feeding animals, was so disconcerting to the observer that it was often impossible to establish predator-prey relationships until the stomachs had been examined.

Occasionally the food of an animal actually feeding was recognised from a distance but the diet was mostly inferred from the contents of excised stomachs. Fish were identified with the aid of two reference books, Barnard (1925) and Smith (1949) but other items were sent to specialists for further study. Remains of food such as cephalopod beaks, fish vertebrae and otoliths could not always be traced to the species from which they originated. Cephalopods were not identified beyond the family category and are referred to here either as squid (*Loligo*), cuttlefish (*Sepia*) and seacats or octopus.

(ii) Land Observations 1946—49.

Some years ago a study was made of the terrestrial habits of seals on Sinclair and Seal Islands (Rand, 1956*b*). This knowledge has helped in the interpretation of their behaviour at sea. Parti-

cipation in summer and winter sealing during 1946, 1947 and subsequent years also facilitated an understanding of specific classes of seal. Many of these facts have been useful in orientating the present investigations. It was unfortunate that simultaneous land observations at rookeries could not be undertaken during the pelagic work.

During the field research of 1946—49, specimens for autopsy were shot with a small (0·22 in.) calibre rifle which was sometimes also used at sea. This weapon was more suitable than the heavier 0·32 in. rifle favoured by sealers for shooting bull seals. Animals were shot in the neck to prevent their escape to the sea. Stomachs of these animals were inspected as part of a routine examination. During sealing operations stomach contents were recorded after skininng but before the carcasses were removed by the sealers.

(iii) Seal-log of R.S. "Africana II", 1950—53.

In 1950 it was suggested that continual observations at sea might throw light on the distribution, abundance and possibly also the food of seals. The oceanographical voyages of R.S. *Africana II* involved a vast amount of consecutive observational work in specific localities. From these research activities was created the " seal-log ", the outcome of accumulated recordings by the ship's officers during routine cruises. The log was discontinued in early 1954 but has been revived again.

The seal-log listed the presence (or absence) of seals together with meteorological and hydrological data (the latter are regularly published as an appendix to the Annual Report of the Division of Fisheries). Many records gave the exact numerical composition of groups of seals and attention was drawn to the size and even the sex of some animals. There were a few notes on actual feeding, specific movements in the water, interference with activities on the ship and other behaviour.

(iv) Seal-marking.

Seals have been marked for various purposes. Originally some recognisable individuals were needed for rookery studies and were marked in several non-permanent ways but further analysis of their pelagic movements demanded more extensive treatment with marks of greater durability.

Branding was part of the routine technique of handling live seals during 1947/48, and was primarily intended for close recognition of individuals on land. The permanency of the brand marks has extended their original use. About 600 animals of different ages were branded with hot irons on Sinclair Island. Animals captured for branding were held individually by means of rope round the neck and hind flippers. Three men were required to handle one large seal.

Branding in 1947 established a stock of marked animals, a few of which still resort to Sinclair Island or are seen at sea. Several animals failed to play a significant role in later observations on land but those that could be found, regularly gave many interesting details about their way of life. Because they were easier to handle, more cows and subadults were caught than bulls. Many animals captured outside the breeding-season disappeared but apparently they were not members of the herd at Sinclair Island. Branding was then adjusted to include cows known to pup on this island. These animals or other younger ones were detected from time to time on the island but only those in conspicuous " hauling-out places " gave really useful data, other marked animals being lost in the crowded herd. Brand marks were etched into the fur of the back and could be seen through binoculars a long distance away. By this means marked individuals could be identified as they lay in " pods " in the water before crawling onto the land.

In 1954 young pups were marked with monel metal (Hasco 19M) tags on the front or hind flippers. These animals could be handled in large numbers by teams of two men. One man applied a tag while the other held the pup. Three teams tagged 2,000 pups in one day on Seal Island (False Bay).

All marking was done on land. No seals were captured alive at sea and thus none was marked there.

(v) Aerial Photography, 1955—57.

Experimental aerial photography involving Seal Island in False Bay showed that accurate counts could be made of the seals. Test photographs were first taken in January, 1955, by a special unit of the South African Air Force (Pretoria) operating a " Wild RC 5A " camera at different altitudes. The reconnaissance was repeated in late November,

1956, and was extended to cover nearly all islands with seal and bird colonies. Photographs were taken from a Dakota aircraft specially fitted for the work. A constant shutter speed of 1/250 sec. and an average diaphragm opening of f8 was adopted for the work.

A somewhat similar coverage of the southern islands of the Cape Province was made at the same time by a photographic detachment of 22 Squadron of the South African Air Force in October, 1955, and again in June, 1956. A Ventura aircraft was used for this work and carried a Vertical F 24 camera. Photographs were taken at about 3,000 feet with shutter speeds of 1/300 sec. Enlargements included some good pictures of the Mossel Bay seal herd. In October, 1956, another coverage was made of the same islands and in March, 1957, a special attempt was made to include all the southern seal rocks. The latter photographs are not yet available for examination.

The aerial photographs were taken with a 30 per cent overlap but their enlarged prints were not inspected under a stereoscope. Partial duplication permitted recounts of certain areas and allowed an average figure of numbers to be drawn in such instances. Enlarged prints, 25 by 25 inches (from a 5 inch negative) gave a satisfactory picture of the seals although the coarse grain of such enlargements was disconcerting when dealing with massed seals. When counting the animals, it was customary to cover the print with thin glass or celluloid, mark the animals with a fine nib and black ink while simultaneously recording their numbers on a mechanical (tally) counter. The photographs were viewed through a stalked magnifier with built-in illuminator, this being more convenient than the watch-maker's glass used at first.

Bulls could readily be identified on the large prints but other classes were not always separated accurately enough to warrant detailed class counts. Seals were difficult to detect in the seaweed-covered intertidal zones.

4. Bionomics of the Seal.

(i) Life-cycle.

Previous investigations of seals at their rookeries established that they are amphibious mammals spending much time on the land (Rand, 1956*b*). They congregate at definite rookeries to breed in the late spring, the bulls coming ashore for some weeks beforehand to claim territories in which the cows give birth, and to mate shortly afterwards. Only one pup is born to each cow and is suckled on land for about ten months. Young seals are therefore at or near their home rookeries throughout most of their first year (November to October). When weaned they are replaced by a new batch of pups so that rookery populations always carry a preponderance of young animals.

Seals have been known to live for twenty years in captivity. They may not reach this age in the wild. Some females mate for the first time in the early spring of their second year, and have a gestation period of up to 15 months before giving birth to their first pup in the early summer of the third year (Rand, 1955*a*). In subsequent pregnancies a pup is born each year during the reproductive life of the cow, which is believed to be about ten years. Young males are sexually mature at about the same age as the females but do not normally acquire breeding status until three years later.

All seals moult in the late summer. The moult is a gradual one and hardly interferes with their general activities at sea.

(ii) Size and Growth.

Seals are large animals reaching a tapered length of eight feet in the case of the older males, and six feet in the adult females. A series of size stadia with advancing age have already been described, attention being drawn to the extreme sexual and age dimorphism in a West coast herd (Rand, 1956 *b*). Occasionally animals of different size may be allocated to distinct ages. The present specimen collection, however, was too small to show detailed age patterns in distribution at sea other than those superficially noted during the cruises. Bulls and sub-adults could be identified in the field but no finer discrimination of age through size was possible. Larger and hence older animals were noticed farther out to sea than younger ones.

Body measurements of seals of various (suture) ages are summarised in Table 6. Extreme values in this table indicate the unusual size range of the seals and can be used as a measure of their food requirements. Bulls are fat at the start of the rut in October, measurements of the girth just behind the front flippers reaching as much as 73 inches. From calculations of blubber thickness, these bulls

may attain a weight of 800 lb. in the summer, cows much less (250 to 300 lb.). The most marked fluctuation in weight is a physiological one, bulls feeding strongly and storing fat before the rut when they abstain from food and lose weight accordingly. This fast may last for nearly six weeks. The bulls are thin, rather scraggy animals in the autumn and winter. The weight of younger seals does not fluctuate so drastically but usually decreases after weaning.

The male seal develops gradually for about four years. Casual observations at the rookeries show that the great size of breeding bulls is maintained for about five summers, after which there is a regression in stature with senility. Females on the other hand, have a fairly constant size. Sexual dimorphism gives the impression of a " bloom " in size for the male but a steady retention of an average size for the female. Seals of a particular herd differ greatly in size and except for the sub-adults similarly-sized animals are rarely together at sea.

(iii) Pregnancy.

One might expect that the nutritional needs of pregnant and non-pregnant females would vary. However, the few animals collected at sea makes it impossible more than to surmise about food discriminations during pregnancy. Possible feeding preferences of pregnant and non-pregnant, lactating and non-lactating cows, deserve further investigation.

Of 144 females caught at sea during 1954—56, 44 per cent (63) were pregnant. Four were senile and non-pregnant. Only one was apparently capable of breeding but was not pregnant. She was collected in November when accompanied by a young bull in circumstances suggesting oestrus. The bulk of pregnant cows were multiparae but eight, captured in February, March and August (see Table 7), were nulliparae.

Of 28 seemingly pregnant females collected before June, 16 were found with free blastocysts in their uteri. Two had developing embryos that had only recently been implanted. No blastocysts were discovered in 12 others which had ovulated. Thirty cows collected after June had visible embryos in various stages of growth. Early stages of the gestation cycle have already been described (Rand, 1955 *a*), but further details about the post-implantation development of the foetus are recorded in Plates XIV and XV. In these plates, changes in size of the foetus are correlated with months of the year; the time of parturition is indicated by a solid triangle.

For three months the blastocyst lies free in the uterus, apparently extracting little nourishment from the maternal tissues. Thereafter, as an enlarging embryo, it develops rapidly to gain a weight of nearly 14 lb. in nine months. From Plate XVI and known facts about the behaviour of the winter yearling, weaning follows a few months after implantation of the new blastocyst, many pups being fully weaned in August when the weight of the foetus attains but 20 per cent of its weight at parturition. The relation between weaning of the previous year's pup and growth of the new foetus has not been fully investigated, but the lactating cow appears to nourish her pup regularly until the latter is able to capture prey itself. Independent feeding by the pup, however, coincides with the accelerated growth of the foetus, the nutritional needs of which may well hasten weaning by making the cow less inclined to feed her old pup. Exceptions have been recorded which confuse these comparisons.

5. General Distribution of Cape Seals.

(i) Location of the Rookeries.

Seal herds are distributed along the coast from Cape Cross (South West Africa) southwards to the Cape Peninsula and thence eastwards as far as Algoa Bay (see Plate II). Fifteen of the known breeding herds resort to islands, Five rookeries averaging about 100 miles apart are found over a distance of about 450 miles along the South coast. On the West coast, however, there are more rookeries (10) which are scattered over a longer coastline (850 miles) at an average distance of about 80 miles apart. The table below gives details of rookeries on both West and South coasts:—

Coast.	*Distance between Rookeries (miles).*	
West	Maximum	180
	Minimum	3
	Mean	78·7
South	Maximum	257
	Minimum	14
	Mean	99·6

In a previous report (Rand, 1955*a*), it was suggested that since cows pup on the same rookeries year after year, it is probable that the herds are

fairly discrete. Furthermore, because they breed in this way on islands or at specific places on the mainland and are so often to be found there, one may always expect seals in the vicinity of the rookeries. The latter, in fact, are distributional centres or focal points of high density in numbers. Parties may frequently be seen radiating out to sea from the island rookeries.

(ii) Recovery of Marked Seals.

Of the various seals branded on Sinclair Island during 1947/48, some animals were slaughtered at short intervals after branding to determine the course of the sexual cycle. Others were inadvertently captured at the same rookery by winter sealers. A few were subsequently sighted at sea or killed on distant rookeries. These animals have provided many details about the pattern of movement at sea and, indeed, gave the first hint that there was an inherent unity among all Cape fur seal herds. The places where branded animals were observed or killed are shown in Plate III. All the animals were marked in their first year.

Recoveries of these branded seals showed that they moved hundreds of miles from their " home rookeries ". This does not mean that there is a definite migratory movement but that the seals disperse widely when feeding. Migration is not confirmed by distributional and other records of the seals. Among points of interest emerging from Plate III (see also Table 8), is the habit of bull seals of frequenting the trawling grounds (*cf.* bull No. 275 was sighted on two occasions among the deep-sea trawlers 450 miles from its place of birth); the habit of hauling out at rookeries other than those at which they were born; and an equally strong habit of breeding at their birth-places.

Metal-tagging of young pups had been restricted to Seal Island in False Bay where nearly 3,000 pups were marked between 1954 and 1956. Recoveries from the tagging operations were as follows:—

Year.	Number Tagged.	Recovered at Same Rookery.	Recovered at Other Rookeries.
1954.....	300	4	0
1955.....	700	80	3
1956.....	1,978	233	11

Table 9 shows where the young tagged seals were recovered at various parts of the coast. The shortest routes to these places are illustrated in Plate IV. Although only just weaned, six yearlings left False Bay and reached Cape Cross by September of their first year (1956). It is likely that their exodus from False Bay was hastened by interference from winter sealers who operated there in July and August. Nevertheless the young animals performed a remarkable feat by moving some 800 miles to arrive at Cape Cross in good condition. They were captured there among other yearlings.

During the previous year (1955) only two yearlings were caught at Cape Cross in their first year, one in July and the other in October; but two other animals were recovered at Cape Cross in the late winter of their second year. Furthermore, two others were caught at Sinclair Island in their second winter and with those taken at Cape Cross demonstrate the mobility of the sub-adults, unfettered by responsibilities.

Other tagged animals were captured near Elephant Rock and Doringbaai on the north-west coast of the Cape Province. One was a yearling and provides additional evidence of the strong northerly movement in spring. Although sealing operations complicate our understanding of this dispersal (winter operations took place at Geyser Rock, Seal Island, Sinclair Island and Long Island as well as at Cape Cross in 1955), it is probably assisted by the northerly flowing Benguela current. No tagged animals have been recovered at south coast rookeries, viz. Geyser Rock, Quoin Rock and Seal Island (Mossel Bay) where, however, winter sealing is intermittent and consequently the chances of recoveries are slight.

Recoveries of tagged animals at the extreme northern part of their breeding range demonstrate conclusively that *the Union seal population mingles with that of South West Africa.* The age at which the young (yearling) seals were captured proves that mixing takes place rapidly among pups being weaned. Tagging is too recent an innovation to throw much light on possible directional trends in the geographic distribution of the mixed herds, branded individuals having shown that they are capable of mixing freely at sea but tend to " home " to their birth places during a summer re-orientation.

(iii) Data from Sight Records, R.S. "Africana II", 1950—53.

Individuals and groups of seals sighted and logged during routine cruises of R.S *Africana II* off the West coast, are illustrated in Plate V. The routine stations stretched from Cape Point northwards to the Orange River. Seals were observed at the most distant stations lying as much as 80 miles from the land (*cf.* Station 2243 in the Annual Report of the Division of Fisheries, 1954, Chart 4). In the St. Helena Bay area, seals were sighted at Station A, 58 miles from the nearest land. The animals were found everwhere between these western extremes and the land. No seals were logged on short cruises made south and south-west of Cape Point.

(iv) Data from Sight Records—Pelagic Studies, 1954–56.

Seals were found in all areas investigated during the small-boat cruises of 1954–56. The pattern of their distribution confirms that recorded by R.S. *Africana II* for the inshore part of the West coast and details will not be repeated here. Distributional records for this western section of the coast were supplemented only on those occasions when inshore hunting approached closer to rookeries than did cruises of the larger research vessel. These instances merely confirmed the higher density of seals near their breeding rocks.

Seals were observed off the South coast at all seaward limits of patrolling (about 22 miles from land).

(v) Data from Occasional Cruises.

Numbers of seals recorded during cruises to the various guano islands in s.s. *Gamtoos* and other ships, hardly supplement those contained in the seal-log or in notes taken during the pelagic studies of 1954—56. Seals were sighted 20 or 30 miles from the coast of South West Africa between the mouth of the Orange River and Possession Island. They were also seen near certain of the northern seal rookeries. In view of the proximity of shipping lanes to these seal rocks, the seals are likely to be seen more often.

Visits to the trawling grounds of the West coast revealed that seals accompany deep-sea trawlers wherever the latter operate. The seals have not been slow in distributing themselves according to the pattern of trawling and are now found over what has become a major feeding ground. This adjustment may not be a new one but suggests that fishing activities direct seal movement on the trawling grounds. The close connection between isolated groups of seals and deep-sea trawlers was especially noticeable when the s.s. *Gamtoos* traversed the Cape Columbine trawling grounds in November, 1956. Seals were recorded 43 miles from land near a fleet of trawlers but were not sighted again farther out at sea.

No Cape fur seals were observed during cruises to Marion Island (1951/52) and to Tristan da Cunha (1952).

6. Distribution off the Western Coast of the Cape Province.

(i) General Distribution.

The whereabouts of seals was studied during all cruises, notes being taken of animals within range of the binoculars of the patrol-boats. As voyages were necessarily made along fixed routes, the recorded dispersal of the animals bears a strong resemblance to the lines of travel through particular areas. Binocular vision broadened this " zone of distribution " to a depth of about two miles. But only in relatively small stretches such as False Bay, was a true impression of distribution obtained in relation to time and space. In such places, movements of the seals could be accurately assessed by using the faster *Schipa*.

Distribution is generally connected with density but the connection is a loose one, so that a wide distribution is not necessarily correlated with a low density. Seals travel fast and far and any record of a particular number in a certain place may be entirely wrong a few hours later (these movements are sometimes not appreciated by fishermen who make exaggerated claims concerning the predation of fish by seals in local areas). Then, too, seals may be scattered singly or in bands. The problem of determining the location of concentrations of seals or even individuals was never satisfactorily solved during the small-boat cruises.

Sight records from the seal-log are plotted in Plate V, for the western part of the search area (records from the pelagic studies of 1954—56 are omitted, being similar for the greater part of this

coast). Sight records from the pelagic studies, however, are shown in Plate VI for the more southerly part of the investigational area. Although the pattern of distribution is obviously influenced by the courses set by the search vessels, certain foci of abundance suggest that some parts of the coast are preferred to others. Stimuli affecting the detailed distribution of various classes of seal are discussed below. Generally speaking, the animals scatter freely about the inshore waters and also extend out to sea for about 100 miles.

(ii) Relation to Age and Sex.

Attempts were made to age seals as bull, cow, sub-adult or yearling and to sex them as bull or cow, whenever they were sighted during the years 1954–56. With the exception of adult males and some yearlings, the only reliable records are animals actually handled on board the patrol-boats. Nevertheless, catch-records and some indisputable sight records from 1956 are given in Table 10 for various months of that year. Numbers of young animals are recorded from the spring and early summer. Few bulls were seen during the winter. The location of these animals at sea during 1956 is shown in Plate VII (the hundred fathom depth is given as a broken line in this Plate).

Yearlings of either sex appeared close inshore from August until November. Their presence here might well have been due to disturbance by winter sealers at False Bay and also at Geyser Island, or to the coincident assumption of independent foraging by the nearly-weaned pups. These causes are interrelated because winter sealing affects the hauling-out habits of the cows, thereby hastening weaning which would otherwise be more protracted. Yearlings are found nearer their home rookeries under other circumstances.

Sub-adult seals were distributed everywhere during the year, their numbers being supplemented by an influx of yearlings in the spring. Cows and bulls were relatively rare close inshore, the latter class being represented by solitary individuals seldom attached to groups of cows or sub-adults. Furthermore, solitary bulls were seen moving to and from various rookeries such as Jacob's Reef, Robbesteen and Seal Island. They were more plentiful when cruises were extended farther from the land (west of Dassen Island or south-west of Cape Point).

(iii) Relation to Surface Temperature.

The presence of seals in waters of different temperatures is shown in Table 11, compiled from data of captures during 1956 only. Animals of either sex and all ages, were found in water with a surface temperature ranging from 10° C to 20° C, the prevailing temperatures of the whole investigational area. Most animals, however, were captured in water with a temperature between 12° C and 16° C.

There is only an indirect restriction of movement over this ten degree temperature range for the West coast of the Cape Province, namely that caused by changing temperatures on the movements of prey. This relationship is again discussed in Section 9 below. On the other hand, little is known about the more general environmental restriction of the Cape fur seal population to the south west corner of the coast of Southern Africa. Reports from the coast of Natal consistently fail to mention fur seals in spite of the abundance of small and large fish (from what is known about the performance of seals off the West coast, the herd at Algoa Bay would seem capable of reaching the Natal coast and participating in the " sardine run " of early June).

(iv) Relation to Meteorological Conditions.

Weather affects the sea variously and the degree of surface turbulence modifies the movements of the seals. Wind is perhaps the most important single weather factor in this respect. Although it lowers temperatures over the land, wind may also increase the hazards that seals encounter when moving through the water. If inconvenienced by adverse weather conditions on land (mostly high temperatures), seals immediately escape to the water (in summer old bulls are nevertheless loath to move although obviously discomforted by the heat as they lie on the hot rocks).

On the other hand, many animals deliberately avoid rough seas and gales by climbing onto the land (breeding rookeries all provide sanctuary against high seas). From the records of marked animals, however, other seals remain at sea on

these occasions. There are various reasons for fluctuations in the herds under the different weather conditions. Increases may be brought about by a return of those animals which were actually near the rookeries all the time, or else almost all members of a herd may seek the land; but many seals stay at sea and ride out the rough weather. Older animals are generally less affected by the rough seas. In the winter, packing of the seal rocks is due largely to the influx of young seals reluctant to weather storms at sea.

Although observations at sea failed to explain the fate of seals during bad weather, there is indirect evidence of a landward movement before such weather breaks. Unfortunately wind and swell over force 3 curtailed hunting from the small craft and interfered with progress over the search areas in 1954–56. Seals may have been in the area but were simply not seen. Observations from the larger R.S. *Africana II* point to few seals at sea during rough weather, but here, too, limitations of sighting the small animals during such weather may give misleading information.

Various wind-speeds and directions were taken from the seal-log of 1951 and summarised in Table 12 to explain the effects of wind on seal movement. Only one-fifth of the records of seals in that year were logged at wind speeds corresponding to the Beaufort Scale force 5, most being taken when the wind was blowing force 2. Nearly 50 per cent of the instances when seals were sighted, occurred when the wind was in the sector south-east to south-west. In 1951 there were 73 records of seals when the wind was blowing but only 20 when it was calm.

(v) Relation to Coastal Topography.

Young seals often laze in the water above shallow reefs (Oude Schip, Logies Rock, Roman Rock and others off the Cape Peninsula), apparently enjoying the continual surge of the waves. These groups are reminiscent of the " pods " which lie over similar reefs near the breeding rookeries. Young seals captured at these places were found to contain fish (e.g. *Chatrabus damaranus*), cephalopods and crustaceans but not necessarily altogether in the same stomach. These items of food are normally associated with this type of habitat.

Groups of young seals congregate in bays and coves but older animals prefer the open sea. The young seals are found on the periphery of kelp beds close inshore. Their presence has an obvious relation to the rock lobsters on which they feed. Hottentot fish (*Pachymetopon*) and other sparids living among the kelp are taken by these seals. Feeding, however, is not the only reason for dallying in the bays, for the seals shelter there during strong winds.

The dispersal of seals in relation to certain sea-bottom contours is shown in Plate VIII (*cf.* Admiralty Chart 2091) for the principal search areas. Because of the restricted search cruises, no definite correlation was found between the distribution of seals and specific depths, other than appears indirectly from the movements of their prey. Cruises were in relatively shallow water and reached the hundred fathom line on only three occasions. It might well be that a distinct " depth barrier " exists farther off the coast than was explored by small boats. Seals were encountered by R.S. *Africana II* at deep-sea stations with recorded depths of 430, 360 and 327 fathoms. Seals accompany trawlers far beyond the hundred fathom line.

A few seals frequent all fair-sized fishing harbours. Some are almost permanent residents of that part of the harbour where fishing boats discharge their catches. While they eagerly take fish thrown from the trawlers and other boats, it is believed that they do not rely entirely on this source of food but seek cephalopods and crustaceans hiding under the harbour installations.

(vi) General Relation to Other Organisms.

Seals were wholly absent from waters affected by inedible plankton such as *Noctiluca* at least on one occasion. Thus a " red bloom " of this species spread over the St. Helena Bay area in mid-1954 and no seabirds or seals were seen there for long periods.

Seals feeding on the surface attract petrels (*Procellariidae*), albatross (*Diomedeidae*) and other seabirds. Only rarely does the presence of petrels indicate the whereabouts of fish. Other seabirds such as gannets (*Morus capensis*) and penguins (*Spheniscus demersus*), however, participate in common meals of pelagic fish.

Because of their interest to man, the movements of the larger fish are well-known. Less is known about the dispersal of the pelagic cephalopods, an item of importance in the diet of the seals, and even the migrations of the rock lobster, another prey species, are not fully known. All the areas

studied in 1954–56 held a great variety of small and large migratory fish. Migrants from the north (e.g. snoek) face big changes in surface temperature when they reach Cape Point and those moving from the east (e.g. geelbek) meet similar obstacles. These temperature barriers (*cf.* Clowes, 1954) also affect many invertebrates. Where they concern the seals, these problems will be discussed under the appropriate food species (see Section 9).

(vii) Feeding Grounds.

The pelagic studies of 1954–56 failed to expose any area specially favoured by the seals for feeding. Similarly the seal-log never consistently reported any concentrations of seals in specific areas. Seals move about extensively, feeding wherever they encounter suitable prey. Special foods such as octopus and rock lobsters are taken in the appropriate environments (inshore kelp beds). Other items are caught at random near the surface or specially sought further below.

Although it is believed that the deep-sea trawling grounds are artificially-sustained feeding grounds of great interest to the seal, the coastal shelf at the hundred-fathom line may well have held desirable food organisms long before the advent of the deep-sea trawler and of the supplies of fish offal so conveniently meted out to the seal.

Seals are less common in areas of inshore fishing where the concentrated night operations disturb rather than attract the animals. Surprisingly few seals are encountered by these boats. The increasing use of echo sounders for daylight fishing, however, may in future affect the seals in a manner similar to that of the deep-sea trawlers.

7. Abundance off the Coast of the Cape Province.

(i) Methods of Assessment.

Because of their mobility and habit of travelling under water for long distances, seals are elusive and not easily counted from a distance. Fortunately they are often present in groups of two or three at the surface where they are unmistakable animals, their movements and characteristic postures attracting attention from afar.

Various techniques have been developed for counting seals on land or at sea. Aerial photographs have proved successful for computing herds in widely-separated regions or at inaccessible places, but are an expensive technique and can be used only for counting those animals on land when the photographs were taken. The technique may be more fruitful during the breeding season when specific classes are ashore in greater numbers than usual. Unfortunately, best flying and photographic conditions do not always coincide with days when many animals are ashore. Aerial surveys, therefore, have severe limitations.

Actual land counts of certain classes, such as the enumeration of individual harem bulls or black pups, give an accurate measure of their numbers. The convenience of counting pups (as compared with bulls) makes this a satisfactory technique. In the present studies, deductions concerning the numbers of females mothering these pups are taken as nearly equivalent to the total number of adult females (in large herds reproductive failure, reaching about 25 per cent, and mortality among the pups introduce limiting factors which must be considered before arriving at final figures of total numbers; in management, however, reproductively-active females constitute the most important class).

Throughout the pelagic studies (during small boat cruises as well as on the R.S. *Africana II* voyages), seals were counted individually whenever possible. The seal-log of R.S. *Africana II* faithfully recorded numbers of seals and every endeavour was made to avoid indefinite terms such as " few " or " many ". Entries in this log are specific although large groups are sometimes described as " 100 plus " (25th August, 1951). It is virtually impossible to count big concentrations but estimates are accepted as sufficiently correct for present purposes: the figures are unlikely to err more than 100 per cent. In other words, large parties of seals listed as " 100 plus " probably contain up to 200 animals rather than say, 500 or 1,000. In Table 21, abundance returns are recorded as stated in the seal-log.

For descriptive purposes in analysing sight records contained in the seal-log and in field notebooks used on the patrol-boats, eight arbitrary *reference areas* have been selected. They are offshore areas through which the bulk of searching took place and coincide with certain routine stations regularly visited by R.S. *Africana II*. The reference

areas adjoin each other as indicated in Plates X and XI. The geographical limits of these areas are summarised in Table 5.

(ii) Total Numbers at Sea.

(a) Gross Numbers.

Seals were sometimes scattered in large numbers over the search areas; at other times none was sighted no matter how vigilant a watch was kept. To gain an idea of the density of seals at sea, numbers for the West coast are extracted from the seal-log and from field-notes compiled aboard the patrol-boats for the southern areas. These numerical records are tubulated in various ways:—

Table 21 shows the total numbers of seals recorded from all parts of the coast for the two periods under review. No more than 2,000 seals were sighted at sea in any year of observation during 1950–53 (West coast), and not more than 900 seals were counted in any year during the small-boat cruises of 1954–56.

The highest monthly average for all the years 1950–53 was only 269 (October) although more than 500 animals were seen in one month of 1951. The monthly average for the whole period 1950–53 was 154. The lowest monthly average for the same period was 17 in January (see Table 22). During the pelagic investigations of 1954–56, the highest monthly average was 221 (October) for the three years. In the latter investigation, estimates of numbers in big concentrations are omitted from the discussion but are marked with an asterisk in Tables 21 and 23.

(b) Seasonal Variation in Numbers.

The monthly averages for each year varied from 138 to 164 for off-shore parts of the West coast (seal-log), and from 19 to over 71 elsewhere during the small-boat cruises. The highest monthly count for any year during 1950–53 was 503 in October, 1951. In the more recent studies of 1954–56, over 81 seals were sighted in that month, this being the highest monthly total for the period 1954–56 (see Table 21).

Low averages came from the months of December and January (see Tables 22 and 23), but minimum figures such as these should be treated with caution as they frequently refer to periods of irregular or incomplete searching. Nevertheless, the reproductive aspirations of males and the maternal duties of the cows in the summer, tend to keep many animals in the vicinity of the land rather than far out at sea and fewer are encountered in the search areas.

Monthly records of seals at sea are expressed as percentages of the annual totals in Table 22 for the seal-log. Three shallow peaks of abundance occur in February, July and October. In the case of the last two months, the fluctuations probably refer to the seasonal influx of yearlings, first as " learner-feeders " (July) and later in October as a group (" weaners ") supplementing a dwindling milk supply by independent and rather widespread feeding. Underlying reasons for the autumnal abundance (February) are not clear.

The abundance of seals in various reference zones throughout the year is shown in Table 23 for the pelagic studies of 1954–56, and in Table 24 for the routine cruises of 1950–53 . Most seals were sighted in zone 5, being slightly more numerous in the spring and summer than at other times. Fewer animals were sighted off shore in zones 5A and 6A. Zonal dispersion is discussed in further detail below.

(iii) Total Numbers off the North-West Coast.

(a) Gross Numbers.

Records of seals in the seal-log refer almost exclusively to the West coast and to that part of it near St. Helena Bay. They apply to reference zones 5A and 6A, both of which are fed by the breeding herd on Jacob's Reef and probably also by the more northerly rookery at Elephant's Rock. A few seals occasionally lying out on Lambert's Bay islet may be disregarded.

From the relatively few observations of the 1954–56 studies, reference zone 5 gave a yearly maximum of only 90 seals in 1956 whereas the other zones carried far more seals. Only 23 cruises were made through zones 5 and 6 but 78 were made through zones 3 and 4 (see Table 3). Observational shortcomings do not warrant further discussion about density in adjacent zones.

On the other hand, the seal-log shows that zone 5 (Jacob's Reef) is decidedly the most thickly populated of the north-west coastal areas, carrying a yearly average of 607 animals as compared with only 55 in zone 5A (deep-sea), 117 in zone 6 (St. Helena Bay) and 252 in zone 6A (see Table 24).

It is of interest that the annual totals of seals seen by R.S. *Africana II* over four years give a remarkably similar daily average. This varies from 21 to 25 animals for the North-West coast as follows:—

Year.	Total Number of Seals Recorded.	Number of Days of Observation.	Average Daily Number of Seals.
1950.....	1,240	50	25
1951.....	1,808	87	21
1952.....	1,729	81	21
1953.....	1,134	54	21

(b) Seasonal Variation in Numbers.

Tables 24 and 25 show that no more than 90 seals were encountered at sea during any year of the pelagic studies of 1954–56 nor was the monthly average more than 320 seals from records accumulated by R.S. *Africana II* during 1950—53. By far the greatest number of seals was sighted in zone 5 when vessels were passing Jacob's Reef. From descriptions contained in the seal-log most of these animals were sub-adults. Highest numbers occurred in July and probably refer to the dispersal of yearlings into the shipping lanes adjoining Jacob's Reef. A secondary fluctuation in numbers takes place in October and is probably due to the pre-rut exodus of non-breeding animals from the land. But this is not clear and they may actually be scattered " weaners " associated with a normal flow of other animals to and from the rookeries. In zone 6 (St. Helena Bay) there is an increase in numbers during October, the outcome of a movement of " weaners " northward through that bay. In zone 6A two prominent fluctuations occur in April and September but the reasons are obscure.

(c) Density of Seals in certain Areas.

On several occasions the seal-log records numbers of seals for specific periods and over measured distances. Thus 81 medium-sized seals were encountered near Jacob's Reef over a distance of about nine miles between 0800 and 0900 hours on 6th November, 1950. In St. Helena Bay, 50 seals were counted on the 12th August, 1951, while the R.S. *Africana II* steamed for an hour and a half in that bay. Sixty pups were counted on the 21st August over a distance of eleven miles near Dassen Island. An average of more than ten seals per square mile was never recorded in the seal-log on these occasions.

To gain an idea of the density of seals in a more extended area, the total numbers of seals recorded in the field note-books for 1956 are compared in Table 23 with the various reference zones in which they were collected. On no occasion was more than one seal per square mile observed. Data from the seal-log of 1950–53 show that the average number of seals per square mile for the three-year period in zones 4, 5 and 6 were 1·1, 0·2 and 1·8, respectively (see Table 25).

(iv) Total Numbers off the Cape Peninsula.

There are three seal rocks (Robbesteen, Duikerklip and Seal Island) near the Cape Peninsula which is here considered to include zones 3 and 4. Gross numbers contained in the seal-log refer only to the northerly part of the Cape Peninsula (zone 4), 498 seals being counted there during 1951 but fewer during 1950 and 1952 (see Table 24). During 1956, at least 217 animals were counted in this zone (see Table 23).

The density of seals in relation to the number of cruises undertaken in 1956 is shown in Table 26. The highest average came from zone 4. Tables 2 and 24 show that 12 cruises by R.S. *Africana II* yielded a total of 498 seals in this area; in 1956 ten cruises by the patrol-boats gave a total of 217 seals.

Although many more cruises were made through zone 3 (51 cruises during 1954–56), the total number of seals was only 228, somewhat less than the three-year total of 259 for zone 4. During 1956, a year of most complete coverage, 145 seals were counted in zone 3.

Numbers of seals off the Cape Peninsula increase in the spring but drop considerably in the summer. This fluctuation is not unexpected as there is no breeding rookery in zone 3 and a natural exodus of adults would take place during the breeding season in spring. The paradox of relatively high numbers in October and November is apparently due to the dispersion of rejected " weaners " from breeding rookeries such as Robbesteen and Seal Island, and probably also from Geyser Rock near Danger Point.

(v) Total Numbers off the South Coast.

The South coast of the western Cape Province was not explored as thoroughly as the West coast although regular visits were made to False Bay. Twenty-eight cruises to zones 1 and 2 during 1954–56 resulted in a total of 193 seals (excluding the big concentrations encountered near Seal Island, False Bay). Because of the incompleteness of the search programme, the density of seals in these areas cannot be discussed in further detail.

In zone 2 (False Bay), numbers of seals were high in February and March and again during November. These peaks of abundance are the outcome of the peculiar summer breeding and moulting habits, the former showing differential exclusion from the rookeries, the latter tending (but only slightly) to keep the seals near the land.

(vi) Rookery Populations of the Western Cape.

Because of the limitations of sight records taken over prescribed areas only, any discussion of total numbers at sea is not complete without some reference to the strength of herds breeding on the land. The seal rocks are small in size and often inaccessible to man thus prohibiting movement near the seals. There has been no proper investigation of numbers at these places. Nevertheless, several somewhat disconnected attempts to make deductions about herd size are of interest. In lieu of anything more accurate, the following sources of information about the island herds are of sufficient value to warrant their inclusion here.

(a) Sealing-catch Figures.

Yearlings form the bulk of the winter catch. Older sub-adults may be included but seldom exceed 5 per cent of the other class. Operations against the seals are conducted exclusively in the winter at Seal Island (False Bay) and rarely at Jacob's Reef, but have occurred in the summer as well at Geyser Rock, Quoin Rock and Elephant Rock. No sealing has taken place on the mainland near Kleinsee nor at Duikerklip (Hout Bay). No sealers have visited Robbesteen within recent years.

The pups of a particular herd are all born at about the same time which coincides with the rutting season. They acquire a certain ceiling in numbers of exploitable animals, which leads to a theoretical "catch expectancy" for that herd. Normal catches are unlikely to exceed this figure except under very favourable conditions. Regular sealing has enabled sealers to calculate this "expectancy", which for present purposes can also be described as the "catch quota". The practice of rotating summer and winter operations at the same rookery has foiled attempts to strike a theoretical mean catch, because summer operations tend to deplete a rookery of some of its winter potential. Herds at Geyser Rock and Elephant Rock were seriously affected in this way a few years ago although they both have good catch potentials. In spite of fluctuations at different rookeries through questionable sealing practices, advantage is taken here of past records to establish the carrying capacity of the Cape seal-rocks and in this way to calculate the approximate size of the herds.

In Table 27, winter statistics since 1935 are presented for five Cape rookeries, with special mention of the years 1954–56 in which simultaneous pelagic observations were made in their vicinity. The maximum number of pups taken during any operation is considered significant in calculating the capacity of the particular rock. Furthermore, until more accurate figures are available, we must accept the sealers' contention that 25 per cent of pups escape them during winter operations; the rate of escape may in fact be greater. Using these factors, a rough calculation can be made of the population of pups and hence of fertile females. The rookeries are capable of accommodating up to 18,000 pups each year (see Table 27). It seldom happens, however, that as many pups are present nowadays.

Altogether 51,738 young seals have been killed at rookeries off the Cape Province since 1946. During the previous ten years (1935–45), 32,393 young seals were captured at the same rocks in the winter. The take of winter seals has almost doubled since the end of the last World War (see Table 28).

Summer catch figures are presented in Table 29 for the same Cape rookeries, and refer to bulls killed during the rut. These operations were conducted at only three out of the six rookeries under discussion. Sealing was formerly rather selective but recently the sealers have tended to cull all breeding males in addition to idle bulls. Catches over a number of years are not therefore a true reflection of the whole population of bulls. Nevertheless, maximum figures are here taken to represent these bulls. No summer sealing has occurred at Robbesteen, Jacob's Reef and Seal

Island (False Bay) and the adult male populations are not known according to this method of appraisal. From a consideration of sealing catch figures, at least 3,000 bulls reside at the western Cape rookeries (see Table 29).

Since 1946, at least 13,850 bulls have been killed in the summer at rookeries off the western Cape (see Table 28). Only 5,581 bulls were killed during the previous decade.

(b) Tag-Recovery Returns.

Because pups are caught in their first year, it was thought that numbers could be calculated by comparing tagged animals with those recovered at the rookery. The return of tags from rookeries other than those where tagging took place introduces several complications that make the tag/recovery ratio unusable until more is known about the effect of dispersal, mortality and sealing procedures.

(c) Land Counts.

Attempts to count pups were made at Seal Island in False Bay and at Geyser Rock during 1956. Thus in January of that year, 6,475 pups were counted on Seal Island (4,036 yearlings were killed there by winter sealers). The staff of Dyer Island reported 2,195 black pups on Geyser Rock during February (1,101 yearlings were killed there later).

(d) Analysis of Aerial Photographs.

Experimental aerial photographs of Seal Island (False Bay) revealed that on the 29th January, 1955, there were 299 bulls, 4,734 pups and 3,096 other classes on the island. About 500 seals lay in clusters and could not be counted individually. The total was thus 8,129 with an accuracy of $\pm$ 500. In October of the same year other photographs gave a total of 3,178 animals of which 164 were bulls. On both occasions maximum numbers of animals were not on the island.

On the 25th October, 1955, other Cape rookeries excluding Elephant Rock and Kleinsee were photographed, the coverage taking place shortly before the annual rut. Few animals were ashore. Their numbers are given in Table 30.

The same Cape rookeries were photographed again on 23rd November, 1956, when many bulls were ashore with the cows. As shown in Table 30, 2,695 bulls were counted on this series of photographs.

(e) Estimated Seal Population of the Cape.

There is hardly any corroborative evidence for the maximum numbers of seals in the somewhat disconnected census techniques so far applied to the Cape rookeries. Yet numbers obtained indirectly from sealing operations give a substantially correct impression of herd size. From Tables 27, 29 and 30, the maximum numbers for the seven Cape rookeries considered here, are estimated to be as follows:—

Bulls	3,500
Cows	18,000
Pups	18,000
Other classes	10,000
Total in round figures	50,000

An attempt will be made in the near future to compute the total seal population through the examination of aerial photographs of all the South African and South West African herds. The present report deals with some 50,000 seals of all classes in Cape waters. These animals account for about 16 per cent of the total winter catch of the Union of South Africa and South West Africa.

8. Feeding Habits.

(i) Feeding Behaviour.

(a) Teeth.

As in the case of land carnivores, seals catch their prey by means of the teeth, tearing and bolting it piecemeal. The teeth are not used to masticate the prey but to reduce it to a size small enough to pass down the gullet. Small prey seldom bear obvious marks of capture.

Most of the milk teeth of the pup persist for five months. Milk incisors are lost before birth, the permanent ones being used for sucking. Other milk teeth are lost in the autumn, their displacement being hastened by the upgrowing permanent teeth and a habit of mouthing floating debris. By midwinter, pups are potentially, if not actually, capable of foraging independently. Not only have they learnt to find their food but they now have a dental equipment capable of dealing with it (Rand, 1950*b*).

Teeth of older animals are shaped for gripping, biting and shearing. Both jaws have long canines especially prominent in the older males. The

second incisor of the top jaw is large and resembles the canine tooth. In practice, the lower canine bears against the upper canine and third incisor in a special indentation, thereby forming a good holding and locking device. When the jaws close, the inwardly-bent canines push the food into the mouth severing off pieces at the same time. The post-canine teeth are all somewhat similar in appearance.

In adult male seals the length of the rows of post-canine teeth is 5 or 6 cm.; they are nearly parallel and are from 4 to 5 cm. apart. The teeth have two partial cusps which give them a sharp "trident" shape. In big males the jaws open (gape) about 15 cm.

The teeth of the yearling are white and unstained until the tenth month. Thereafter they become brown or black-coloured at the base, a result of eating cephalopods, the ink from which forms a deposit round the teeth. The teeth of cows are stained more than those of other classes.

Wear of the teeth of young animals is negligible but may become appreciable in older animals. The tips of the post-canines are often considerably abraded. It was thought that this might be due to the cumulative effect of eating hard-shelled crustaceans or the calcareous "bones" of cuttle-fish but this is not consistent with the habit of bolting food during feeding.

(b) Handling the Prey.

Seals surface to handle prey such as big fish, octopuses or large rock lobsters. Small fish (under 12 inches long) and squid are swallowed below the surface. The front flippers do not hold the prey while it is being eaten but may be used to wipe the snout during and after feeding. Captive octopuses grip the head of the seal with their long tentacles but these are knocked aside by the flippers or by strong head-shakes. Surface handling is invariably accompanied by violent movements as the prey is waved about and large pieces are torn off. Certain fish are seized in the soft belly, a single jerk tearing out prized pieces of food (liver and stomach). Although they were never seen deliberately to throw fish into the air in order to swallow them head-first, seals in zoos twist fish thrown to them so that the scales do not interfere with swallowing. Small fish such as maasbankers are surprisingly unscarred and bear only one or two teeth-marks behind the head. It is not known if they are seized head or tail-first. The fish are apparently captured individually and swallowed whole under the water. On one occasion, however, the seal-log (29th October, 1950) reports a seal as eating a pilchard on the surface.

Pieces of the prey are bolted by the seal which then retrieves the rest, chewing and breaking off more pieces. Particles of food are snatched by sea-birds attracted to the splashing seal. Large octopuses take longer to handle, but are systematically consumed, being unable to adhere to the loose hair of the seal's head and so avoid its jaws. Pieces of tentacle found in the stomach bear a rough relation to the width of the jaws. A cow seal caught while eating an octopus, had chewed off pieces of tentacle weighing about 50 gm. each.

(c) Hunting Associations.

Seals leaving a rookery in small parties are conspicuous on calm days. Otherwise the daily feeding exodus is unobtrusive. The intensity of the movement varies, small groups making their way to deep water in a leisurely manner, or successive waves of animals travelling in definite directions (e.g. the passage of seals to and from False Bay *via* Cape Point). These groups no doubt amalgamate when food supplies are concentrated. As this seldom happens (cf. Tables 11 to 16), the seals scatter to become solitary rather than cooperating hunters. Groups far out to sea consists of one or two cows with a single bull or sub-adult male, or when nearer shore, of sub-adults only. Groups of males patrol the trawling grounds. Solitary cows with their yearling-pups are often seen together near a rookery.

Young seals frequently float at the surface close beside drifting kelp. Balanced by their outstretched flippers, the animals appear to derive a feeling of security from the presence of the weed, to which they bear a strong resemblance from afar. The association was so strong that during the pelagic investigations, the patrol-boats were instructed to seek seals near floating kelp, big rafts of which invariably hid one or two animals that were captured without difficulty.

All seals feeding inshore on large prey such as kingklip (*Genypterus capensis*), octopuses or rock

lobsters were alone. The spatial limitations of solitary hunting (no territorial significance is implied) were noticed on one cruise round the Cape Peninsula on the 28th September when a single seal was seen eating an octopus near Duikerklip. Half an hour later another seal was seen mouthing a large rock lobster off Slangkop. A third animal alone near Cape Point, was feeding off a large unidentified fish two hours afterwards. The seals were dispersed along a twenty-mile strip of coast and were the only animals encountered.

It is claimed that seals band together and drive shoal of small fish into shallow water or else control pelagic shoals so that they can feed leisurely at the surface. Some form of cooperation may indeed occur but the pelagic investigations of 1954–56 showed that this is only incidental. The seals feed together only when there are large supplies of prey, attacking and eating at random. During cruises on the South coast, schools of fish were frequently seen at the surface unmolested by birds or seals. Groups of diving sea-birds, however, are known to attract and guide seals and porpoises, all species converging on the common meal. On two or three occasions small shoals of fish were attended by single seals, the latter swimming casually round or through them. It could never be established whether a shoal (an entity in any case) was controlled by the encircling seal which was grazing without obstructing the fish.

The greatest concentration of feeding seals was seen near Seal Island (False Bay) on the 7th March, 1956, the seals trailing a shoal of maasbankers without encircling them. The possibility that fast-moving shoals out-swim, out-dive and otherwise confuse the seals gained some support from the meagre contents of stomachs of animals captured during this incident.

When avoiding predators or when seeking small prey themselves, fish shoals may move into coves where all exit can be barred by other predators. On the 1st August, 1955, a school of maasbankers was trapped in this way in a small lagoon on the coast of the Darling district near the Robbesteen rookery. The fish had come inshore after anchovies when they were caught by the seals.

(d) Rate of Travel.

Pinnipedes in captivity can swim under water at speeds of from four to eleven miles per hour (Meinertzhagen, 1955). Cape fur seals can keep pace for a short distance with a patrol-boat travelling at eight knots. Under these circumstances they are not as fast as porpoises.

Seals move just below the surface, apparently only breaking through to breathe and control the general direction of travel. They do not necessarily travel faster when " porpoising " out of the water, a habit enabling them to detect pursuers or orient themselves when approaching a rookery. When hard-pressed they sheer away from a boat, sprinting under water for some distance to elude their pursuers.

Seals are able to reach deep water within a few hours after leaving the rookeries. They can return to land from distant places relatively quickly.

(ii) Frequency of Feeding-journeys.

Through studies of suitably-marked animals-information was gathered about the length of their stay at sea. Calculations were based upon the time of leaving and returning to land. Seals are known to spend hours in a " pod " before leaving the vicinity of a rookery. The animals seldom leave singly but prefer the company of others. It could never be ascertained how the feeding parties are originally formed.

When away from the land seals use their time to find and capture prey, to digest it at the surface, to rest (not synonymous with digestion), to escape being battered by high seas and to travel for reasons other than the capture of food (e.g. the little known inter-rookery movements of bulls during the spring). Time at sea, therefore, should not be construed as feeding time only. Nevertheless, as most pelagic movements are associated with the pursuit of food, the duration of the sea-trips (feeding-journeys) is here considered to have a direct bearing on the food requirements of each class of seal.

(a) Individual Records of Bulls.

Breeding or harem bulls stay ashore for five weeks at rookeries unaffected by summer sealing. Unfortunately none of these animals had been marked at the onset of the rut and the average time spent ashore is not fully known. Bulls rely on their thick blubber to maintain themselves over the long summer fast. Some are thought to interrupt their stay ashore by limited local foraging (especially when driven to sea by the sealers). Fresh

regurgitated remains on the rookery suggested that territorial demands may not be so rigid that all animals totally abstain from food. Nevertheless, most bulls if leaving their territories, do so only temporarily to seek relief in the water and not to feed. Idle males, even if holding territories, would not have the same stimulus for prolonged fasting.

From observations on Sinclair Island, bull " A " was 22 days ashore before leaving his territory for five days at the end of the rut (see Table 31). This bull returned for four days but thereafter spent two or three days on land followed by six to nine days at sea. Two months after the rut, it was hauling out regularly after seven to nine days at sea. Other bulls had a greater freedom of movement, absenting themselves for nine to 17 days or even longer. It is unlikely that all this time was spent feeding at sea.

Bulls are rarely more than three weeks away from the rookeries during each non-breeding month. Thus bulls " 485 " and " G " were punctual in their arrival from the sea, the former animal absenting itself from 18 to 20 days and staying on land five or six days, while the latter spent 15 days at sea or away from the Sinclair rookery. In both cases the duration of absence could be predicted.

Solitary males feeding on fish offal in certain fishing harbours show a different sequence of attendance, the tranquillity of feeding under these somewhat artificial conditions attracting rather than disturbing the seals. Nevertheless, numbers of these seals fluctuate for reasons other than a diminution in the food supply. The bad physical condition of some of the animals is often noticeable.

Feeding periods of bull seals amount to two or three weeks every month (except in the summer). If the breeding time of six weeks is excluded, *bulls are away from the land for* 22 *to* 34 *weeks each year.*

(b) Individual Records of Cows.

Pups drink milk for eight or more months so that a cow spends much time on land suckling her young. She is away for longer spells in the spring than in the summer, the needs of her pup being less then. Immediately after the new pup is born, the cow goes to sea frequently but for short spells. After two months, the cow is ashore roughly 60 per cent of her time (see Table 32). Although few records come from the autumn and winter, it is believed that the spring spells of five to ten days at sea do not vary very much. The inclement weather of the winter may well force animals ashore more often than in other months.

Cows spend 35 per cent of their time on land in September but this decreases shortly before the new pup is born during October or November. Cows do not leave the land until impregnated, mating about five days after the birth of their pups. They lie on land for nine days during a so-called " lying-in period ". Thereafter they go away for two days at a time until the pup is a month old. Movements of cows which lose their new pups but still suckle ones of the previous year, do not deviate substantially except at the birth of the new pup. Thus during observations on Sinclair Island in 1948/49, cow " L " did not vary her trips to sea even when about to pup, but cow " 251 " was at sea only once during November when the pup was born. Cow " 251 " was at sea six or seven times a month, both before and after parturition. The pre- and post-partum attendance of these two cows that also suckled pups of the previous season is shown in Table 33.

A cow shot 11 days after the birth of her pup had no trace of food in the stomach. Of adult cows shot at random on Sinclair Island during 1947–49, none had traces of food in October and November, and only two (12 per cent) had traces in December. Four cows (25 per cent of those examined) had food items in their stomachs in January. The short recorded trips to sea immediately after mating would restrict feeding (if any) to purely local areas.

Unemployed cows, that is those that lose their pups, follow much the same routine of attendance as the nursing females, spending from 20 to 40 per cent of their time on land (see Table 34). Their attendance varies according to the weather and proximity of food supplies.

Feeding periods of adult cows range from one to nearly three weeks per month. *During a year, cows are actually at sea for* 12 *to* 35 *weeks.*

(c) Movements of Other (sub-adult) Seals.

First-year seals do not feed extensively until they are fully weaned. The duration of weaning varies considerably; thus it may be complete at eight months but can last up to eighteen months of age. Old pups that lose their mothers are not fostered and this might well force them on an independent diet sooner than is the case with other milk-fed pups. At seven or eight months the young seals play in bays or coves up to five miles away from a rookery but return to land after a few days (some yearlings return every evening). The dispersal of older yearlings to more distant places poses some unexplained problems in the nutritional needs of these pups. Milk satisfies the yearling for many months and supplementary feeding is not widespread. There is thus no real need for the young animals to perform long feeding journeys. Fish and marine organisms abound near the rocks where thousands of healthy pups are domiciled.

By the start of the breeding season many yearlings debarred from the rookeries are forced to seek their food and only occasionally return to land. The gradual dispersal after weaning commences in July but becomes more evident by late October when the rookeries take on a deserted appearance.

Records of the movements of second and third year seals are few. From December until February they spend four to eight days on land each month but little is known about their movements during the winter (summer records are given in Table 35). In calm weather they stay away from the land for as long as three weeks. Young females are impregnated during their second year and bear a pup in their third. Their movements are considered to be similar to those of older cows. There is no information about the movements of four or five-year old males.

The amount of time actually spent at sea during a year ranges from only a few weeks for the one-year old seal to about 38 *weeks for older sub-adult seals.*

(d) Feeding Periods in Relation to Meals.

If considered as the entire time spent at sea, feeding periods have a bearing on the amount of food needed by a seal but they do not show how much time is actually spent in handling the food. The concept of a " meal " is of more value as a unit of feeding but, because of the elusiveness of the seal at sea, the full relation of a meal to a feeding period can only be surmised. Land observers can measure the duration of the feeding periods but the number of meals taken or the success of feeding is not as easily demonstrated. Evacuation of the stomach obscures the tempo of ingestion over a stipulated period. One cannot be sure, for example, that items in a stomach were all taken say, over 24 hours, although this is thought to be the case. Seals regurgitate indigestible remains and thereby destroy proof of former meals.

From the circumstances of many captures during 1954–56, it was apparent that feeding occupied only a small part of the stay at sea. Stomachs contained items in varying stages of digestion and the amount and nature of food comprising the meals also varied. Evacuation of the stomach takes about four hours but the intestines are not cleared till some 36 hours later (see Section 11). It is doubtful whether the seal takes more than three big meals in a five-day feeding spell. A meal consisting of a large octopus would probably not be duplicated the same day but meals off small fish or squid undoubtedly are. Unlike land carnivores that offer a " kill " as a direct measure of predation and food needs, the seal has no such convenient unit but probably feeds moderately for several days, taking small prey at every opportunity. Unlike its land counterparts, a seal is at a disadvantage over large prey, a single one of which, if it could be caught, would obviate hunting for a long time.

Seeking and capturing the small prey upon which the slow-moving seal subsists, dissipate its energies and cause it to move far and wide in what must often be fruitless searches. Light meals are the rule [see Section 8 (vi)] but how these eventually stimulate the seal to conclude a particular feeding spell is not known.

(iii) Surface Rests.

Seals sleep or laze at the surface of the sea. They rest like this throughout the day when the sea is calm. Animals captured in these circumstances had taken food at various times beforehand.

Rest periods obviously diminish the time for getting food. One may wonder, too, why the seal rests in the water when it spends so much time on land. Physiological limitations connected with sub-surface movement indicate that these rests are obligatory.

Harrison (1955) has conveniently summarised many of the subtle adaptations for successful diving in aquatic mammals. He points out that to dive and to work at great depths depends upon a more economical use of oxygen. This is brought about by efficient swimming and the temporary halting of unnecessary metabolic activities. Seals which capture prey underwater, must surface for digestion and evacuation of the stomach before resuming more meals, but they must also rest to recover from the physiological adjustments made during their underwater journeys.

(iv) Feeding in Relation to Time of Day.

Because of navigational difficulties, all searching during 1954–56 was conducted during daylight. Seals could not be sighted at night. It might be thought that observations hold a definite bias in favour of feeding during daylight hours but examination of stomachs and actual instances of feeding showed that the seals do indeed hunt and eat extensively during the day.

Land observations demonstrated that seals climb out of the water at sunset, packing the rock overnight but dispersing again during the day. Seals near enough to their own rookeries (of any other seal rock) attempt to gain the land by nightfall. These local movements do not affect the foraging parties which are at sea day and night for the length of their particular feeding journey. Seals may either sleep at sea or move about actively during the daytime. Little is known about corresponding activities at night.

To interpret their activities at sea, the presence or absence of food was correlated with the time of capture of the specimens. The number of empty stomachs collected at various times of the day is shown in Plate XVII. The bulk of these came from animals killed between 0800 and 1100 although fresh food was taken at other times of the day. These observations do not confirm (but cannot reject) a belief that seals are nocturnal feeders dependent upon the luminescence caused by their prey and its habit of moving to the surface at night.

Rock lobsters were captured throughout the day; small surface fish tended to be taken in the morning rather than at other times.

(v) Depths to which Seals Dive.

The Northern fur seal, *Callorhinus ursinus*, reaches depths of 240 feet or 40 fathoms (Scheffer, 1946). To ascertain how deep the Cape fur seal dives, an attempt was made to analyse the trapping of seals in otter-trawl nets shot at 100 fathoms. The seals, however, can easily enter the cod-end of the net as it rises to the surface and their point of entry need bear no special relation to the trawling depth.

Skin divers of the South African Navy recently reported Cape fur seals at a depth of 170 feet (28 fathoms).

The bulk of seals are not required to dive deeply for their prey. Many animals feeding on the surface were encountered over depths of 20 to 25 fathoms. Octopuses found in the stomachs of seals during 1954–56 had been caught in shallower water.

(vi) Fasting.

Seals stay ashore several days at a time and do not feed every day. To some extent they follow the carnivorous habit of not eating between meals. Fasting may last for a few days or for several weeks depending upon the presence of food, difficulties of access to it, or preoccupation with other activities such as mating. The blubber of the Cape fur seal is not only called upon to maintain high insulating properties but may nourish the animal when it is fasting.

Scheffer (1950) measured the intestine of a male Northern fur seal and found that it was 124 feet long. He concluded that, when combined with the stomach, this large alimentary tract enabled the seal to feed heavily and then fast for a long time. The intestine of the young Cape fur seal is not as long. A sub-adult male (body-length 129 cm.) with anchovies and squid in its stomach, had a large intestine (anus to caecum) of 78 cm. or not quite three feet long, and a small intestine (caecum to stomach) of 2,175 cm. or nearly 72 feet long. Another young male with milk in its stomach had a large intestine 60 cm. long and a small intestine 1,220 cm. long. The capacity of the alimentary tract enables the seal to visit distant hunting grounds, obtain food and return to the rookeries (or lairs) to digest its food leisurely.

9. General Account of the Food.

The contents of stomachs of seals taken during the pelagic studies of 1954–56 are described in two ways. First, special tables are drawn up to list the number of stomachs in which each kind of item appeared, as well as the number of items in each stomach. This method was particularly useful when discussing stomachs containing well-digested food in insignificant quantities (see Tables 40 to 42*b*). The numerical relationships are also expressed as a percentage composition of the total food items (Tables 42*a* and 42*b*).

A volumetric method of describing the contents of the stomachs was more appropriate when the items were fresh or only partly digested. In this alternate method of describing the contents, the volume of the items is expressed as a percentage intake for the particular individuals or for the whole series of stomachs examined (see Table 44). This method gave a more correct picture of feeding than in cases where indigestible remains of prey had been in the stomach for a long time. Preference was given to a volumetric rather than a gravimetric analysis. As the specific gravity of fish and cephalopods is nearly one, there is little difference in the use of these quantitative methods.

(i) Based upon Captures on Land, 1946–49.

Although this report deals primarily with the food of seals caught off the Cape Province, other evidence of their diet came from animals killed on land elsewhere. Most of this information was obtained at Sinclair Island but dead seals were examined on other parts of the South African coast during various sealing expeditions.

(a) Specimen Collection, 1948–49.

Of 364 seals of various ages specially shot on Sinclair Island to provide information about their general biology, 86 per cent (315) were empty. Of the 49 stomachs with food, 43 per cent held cephalopod remains, 39 per cent fish and 28 per cent had crustaceans. Twenty-seven stomachs contained stones. Three stomachs from yearlings were partly filled with milk (see Table 36).

In this collection of stomachs, only 24 had material weighing more than 10 gm. These stomachs are analysed in detail in Table 37. It became apparent that the stomach is evacuated at sea and that the seals do not return to land for this purpose. As they defecate freely on the land, it seems certain that intestinal digestion is completed some time after they return there.

(b) Inspection of Seal Catches.

Bulls were carefully examined after skinning by sealers during the summer of 1946. Many animals yielded information already included in Tables 36 and 37 but details of 132 other bulls are listed in Table 38. Seventeen other bulls were examined during the summer of 1947 and are included in this table.

Sealers know that rutting bulls carry no fresh food in their stomachs. This habit of fasting was confirmed by independent examination of the bulls killed during the summer operations. The post-mortem dissection of 149 bulls in October and November showed that all had less than 10 cc. of edible matter in their stomachs and 50 stomachs had no trace of food at all (see Table 38). Two stomachs contained stones. Five stomachs had fish bones, 14 had cephalopod beaks or pens, and 89 had varying quantities of liquid or mucus; yellow, pink or white particles were suspended in this fluid. None of these bulls had eaten crustaceans.

During various winter operations, 319 yearling seals were specially examined on Geyser Rock, Seal Island and Sinclair Island. Information about their stomach contents appears in Table 39 which excludes yearlings already referred to in previous tables. Twenty-seven per cent (85) of these stomachs were empty, 65 per cent (206) contained stones and only 28 stomachs held milk; six other stomachs held traces of crustaceans, three had fish and one contained cephalopod remains. Pieces of seaweed were found in two stomachs.

Yearling stomachs opened at Cape Cross (South West Africa) during July, 1951, contained numbers of the shrimp *Micropetasma africana*.

(c) Individual Items in Stomachs Collected on Land.

Crustaceans.

Yearling seals from Sinclair Island had eaten rock lobsters (*Jasus lalandii*) but others at Cape Cross had captured the shrimp *Micropetasma africana* and the swimming crab *Ovalipes punctatus*. Other yearlings at Geyser Rock had eaten red crabs (*Plagusia depressa*) and megalopa larvae. Six isopods, *Excirolana* and *Aega*, were found in year-

lings from Sinclair Island. Some of the isopods were caught by the young seals but others came originally from the stomachs of larger prey.

Cephalopods.

Beaks, broken pens and particles of flesh were the only remains of cephalopods in the stomachs. Because of its flexibility and chitinous nature, the *Loligo* pen resists maceration. Pens over 12 inches long were found in several stomachs or lay on the rookery. The structure of the pen would encourage regurgitation and indeed it is the most common item in food traces lying on the land. Judging from the different beaks, cephalopods of all sizes are taken. The light-coloured beaks of the pelagic species were more numerous than the large black ones of the octopuses.

Yearling seals eat octopus at the edge of the rookery but may lose their prey in the waves. Mangled remains of the latter were occasionally washed onto Sinclair and Seal Islands.

Fish.

Pilchards (*Sardinops ocellata*) were present in stomachs opened during February and December at Sinclair Island. One adult cow had eaten nine pilchards (as indicated by stomach counts), the residue of which weighed 320 gm.; another cow had eaten 12 pilchards, the partly-digested remains of which weighed 480 gm.

Maasbankers (*Trachurus trachurus*) were found in one male stomach, 72 of these fish having been eaten by this seal. Cape mackerel (*Scomber japonicus*) were found in one seal, snoek (*Thyrsites atun*) in another.

Fish remains in the stomachs of seals caught on land were all heavily digested and consisted of abraded vertebrae or skull bones, otoliths and occasional pieces of flesh. Much of this residue could not be identified and yielded little information of quantitative value.

(ii) Based upon Captures at Sea, 1954–56.

Of the 245 stomachs specially taken at sea, 22 per cent (54) contained nothing at all, 14 per cent (34) had stones only and nine per cent (22) carried traces of food less than 10 cc. in volume. These food traces were the beaks and pens of small cephalopods, fish bones, otoliths and caecae, and pieces of the shells of crustaceans. Of the 157 stomachs analysed according to the frequency of occurrence and volume of the various contents, 135 gave information of interest.

From Tables 40 to 42 *b*, fish foods were found in 124 stomachs (79 per cent), cephalopods in 83 (53 per cent) and crustaceans in 31 (19 per cent). Squid were numerically the most important of any prey species but were closely followed by maasbankers and pilchards. The three major food species, however, occurred roughly in the following numerical ratio:—

4 fish: 3 cephalopods: 1 crustacean.

Fish and cephalopods are taken freely throughout the year. In the spring both these foods reach the same proportions.

Fish was a major part of the diet by volume, being 67 per cent of all edible contents. Cephalopods comprised 21 per cent of this volume and crustaceans two per cent (see Table 43). The volumetric ratio is thus roughly: 30 fish: 10 cephalopods: 1 crustacean, but it is believed that this ratio would have to be altered if the original volumes of the food were accurately known. While lengths of known fish species can be calculated from the size of the head and certain bones, the cephalopod beak or broken pen, from existing knowledge of these animals, do not permit such computations of body size and hence of volume.

(iii) Based upon Casual Reports.

Seals are scattered over the trawling grounds, at popular angling places or in the centre of intense line fishing. They are seen by rock anglers, line fishermen, rock lobster fishermen and trawlermen. The seals arouse the interest and indignation of the fishermen from time to time.

From miscellaneous accounts and angling reports (cf. Biden, 1930), seals are known to feed on the following marine animals:—

Fish.—Snoek (*Thyrsites atun*); Cape Salmon (*Atractoscion aequidens*), Yellowtail (*Seriola lalandii*), Mullet (*Liza ramada*), Cape mackerel (*Scomber japonicus*), Maasbanker (*Trachurus trachurus*); Pilchard (*Sardinops ocellata*); Galjoen (*Dichistius capensis*), Red stumpnose (*Chrysoblephus gibbiceps*).

Cephalopods.—large octopuses.

Crustaceans.—Rock lobsters (*Jasus lalandii*).

During deep-sea trawling, seals take a variety of fish thrown to them by the trawlermen or disposed of as offal. The fish eaten are John Dories (*Zeus capensis*), Stockfish (*Merluccius capensis*), Kingklip (*Genypterus capensis*), Rattails (*Coelorhynchus fasciatus* and *Macruroplus nigromaculatus*).

(iv) Based upon Regurgitations.

Many rookeries are completely washed by spring tides, others have areas untouched by the sea. Small pebbles, brown seal hair, faeces, fish bones, cephalopod beaks and pieces of rock lobster shell accumulate in crevices or lie about on the rock. Such debris has obviously been deposited there by the seals. Remains of food are spewed up when the animals lie on the land and indeed it is a common sight to see them coughing violently as they rid their stomachs of some indigestible remnant. Although the items are badly broken or eroded, they can readily be identified as fish, crustacean or cephalopod remains. Stones and nematodes are also regurgitated.

Vomiting is a voluntary act intended to clear the stomach of unwanted matter. As small pieces of cephalopod beak and fish bones appear in the faeces, regurgitation is not a necessary sequel to all meals.

(v) Based upon the Faeces.

Seals defecate on land or in the water. Excreta vary from a yellow liquid to a greyish semi-solid. It has been suggested that cuttlefish ink gives seal scats a yellowish colour, fish stain them gray and crustaceans reddish (Hamilton, 1934). Dark grey faeces was found in a sub-adult Cape fur seal that had eaten both maasbankers and squid. Milk-fed pups void a yellowish liquid faeces.

(vi) Amount of Food taken by Individual Seals.

To establish how much food is usually taken by a seal, the total weight of items in various stomachs is plotted on a frequency basis in Plate XVIII. Most stomachs had contents weighing less than 1,000 gm. (2 lb.), a few had contents over 5,000 gm. (11 lb.).

The amount of food eaten depends upon storage facilities. Thus herbivores can generally eat more in bulk than carnivores. Scheffer (1950) filled the stomach of a fasting male Northern fur seal (405 lb. body-weight) with tap-water and found that it could carry 39½ lb. of water. The distensibility of seal stomachs is thus well-known and perhaps has led to the belief that the seals could accommodate food to the extent of more than one-tenth of their body-weights. From field observations it is unlikely that they ever eat as much as this at one meal.

The greatest amount of fish food in any stomach collected during 1954–56 amounted to 10,380 gm. or nearly 23 lb. of maasbankers eaten by a bull seal. This animal was shot at 0900 SAST near Dassen Island under circumstances suggesting that it had been able to feed freely. This weight of food is thus a good measure of the maximum intake of prey of this nature for any single meal. *The mean weight of fish in all* (124) *stomachs, however, was only* 981·5 *gm. or* 2·1 *lb.* Much of this prey is taken individually so that average quantities on this basis do not give a complete picture of consumption per meal.

The greatest amount of cephalopod food in any seal investigated in the 1954–56 studies was 13,110 gm. or nearly 28·8 lb. of octopus, taken from a bull seal shot near Hout Bay in April. *The average weight of cephalopod in all stomachs* (83), *however, was* 400 *gm. or nearly* 1 *lb.* Remains of octopus of uniform size were often found in the same stomach.

Cape rock lobsters reached a weight of 1,700 gm. or 3·7 lb. in a yearling stomach. *The average weight of rock lobsters, however, was* 314·6 *gm. or* 11 *ozs.*

The above amounts of food were freshly taken and usually referred to a single prey species. Mixed items never acquired the same weight or volume as similar ones. Different prey are usually captured over a long period and they cannot reach as great a weight or volume in stomachs as similar prey consumed in one place.

It is often stated that seals are wasteful feeders, biting out the stomach of a fish and allowing the rest of the body to sink. This may be true of seals feeding on fish protruding through the meshes of an otter trawl net or hooked on the end of a line. Solitary seals handling their own prey do not waste any part of it. On more than one occasion feeding seals were eventually captured only because of their reluctance to leave drifting pieces of prey.

10. Individual Food Items.

(i) Prey of Major Economic Importance.

(a) Fish (see Appendix A).

Small schooling fish such as maasbankers, pilchards and Cape mackerel constituted 80 per cent by volume of the fish food recorded during the pelagic studies (see Table 44). These prey formed 60 per cent by volume of all the main edible items and are therefore an important part of the diet of the seals.

Maasbankers were in a greater proportion of seal stomachs collected during 1956 than were pilchards, but they were taken in about the same quantities during previous years. Such a shift in the nature of the dominant prey may well be due to its disappearance from the collecting areas but this was not confirmed owing to lack of uniform collecting. Percentage frequencies for these two fish species eaten by seals during the two periods are:—

Years.	Maasbankers.	Pilchards.
	Percentage.	Percentage.
1954/55.....	8·7	9·7
1956.....	39·1	11·1

Numbers of maasbankers and pilchards in seal stomachs varied from 1 to 113. Large numbers of maasbankers were taken in March and August, while most pilchards were caught in February and September. In an endeavour to find out how many of these small fish were taken at a single meal, stomachs containing them are compared with the actual numbers in each stomach. Most seals took from 10 to 24 maasbankers, or similar numbers of pilchards per meal. In spite of their schooling habit whereby large numbers of catchable size congregate together, the fish were never caught in excessive numbers, meals comprising ten fish rather than many more (only two stomachs had over 100 fresh maasbankers).

Because there might be seasonal variation in predation of these small fish, numbers of stomachs containing the different species were plotted against the months of the year. More seals had eaten maasbankers during March and April than at other times of the year (except perhaps during May and June). Pilchards had been eaten in August mainly, but they were also caught by seals throughout the year (except in April). Anchovies were taken in October, November and December.

Large-size schooling fish are not likely to be numerous in single stomachs and even a ceiling is reached in the size of small fish. In the case of 30 seals with maasbankers that could be measured accurately, 50 per cent of stomachs had fish falling within the 15 to 25 cm. length-group, 27 per cent under 16 cm., and 23 per cent over 26 cm. The percentage of maasbankers in the various body-length groups varied from 70 per cent for fish between 16 and 25 cm. long, to 21 per cent for those under 16 cm. and to only 9 per cent for fish over 26 cm. Only nine seal stomachs contained pilchards that could be measured accurately, five (56 per cent) of these stomachs had pilchards between 16 and 25 cm. long, 33 per cent over 26 cm., and 11 per cent under 16 cm. No pilchards and maasbankers were longer than 35 cm. but, on the evidence of certain bones, it is believed that larger sizes are indeed caught by seals far from the shore.

Seals caught their largest maasbankers in February and August; the largest pilchards in August. Small maasbankers (under 10 cm. long) were taken in March.

Seals caught in the early morning had often been feeding on pilchards. Fresh and partly-digested traces of these fish were found in stomachs collected between 0700 and 0800 hours. Nevertheless, the bulk of fresh pilchards and maasbankers came from stomachs collected between 0900 and 1200 hours. Fresh fish were also found in the afternoon collections.

Occasional concentrations of seals sighted between Table Bay and Saldanha Bay had preyed upon small fish. In seeking to discover how the seals came to encounter these fish shoals, the position of the seal packs was correlated with surface isotherms. Pilchards and maasbankers were caught in seawater of surface temperature varying from 13° C to 15° C. No concentrations of seals and fish were detected in October when the seals were widely dispersed. It is believed that the fish shoals were encountered fortuitiously by seals radiating from their rookeries.

Large schooling fish such as snoek and yellow-tail appeared in insignificant numbers in seal stomachs from False Bay, the former species in March and the latter in October. These dates coincide with the seasonal influx of the fish migrants into the Cape Peninsula areas.

During 1954–56 seals preyed upon a variety of other fish differing considerably in size and habits. A single steenfish (*Chilodactylus fasciatus*) was taken near Hout Bay in April, another one near Camps Bay in July. A cobbler (*Alectis ciliaris*)

was caught off Danger Point during October but does not appear in other stomachs. White stumpnose (*Rhabdosargus globiceps*) were caught in False Bay during October when they were a common fish in this area. It was surprising that more stumpnose were not found in the stomachs. A single dageraad (*Chrysoblephus cristiceps*) was caught by a female seal in False Bay during October. Jacopevers (*Helicolenus maculatus*) were taken in False Bay in February and in the case of *Sebastichthys capensis*, from rock lobster nets at Camps Bay during December. A young seal had raided these nets after feeding on octopus elsewhere. Silverfish (*Argyrozona argyrozona*) were recorded from False Bay. Stockfish were caught in False and Table Bays in October and December. A single panga (*Pterogymnus laniarius*) was found mixed with clupeid and shark remains in the stomach of a female seal caught near Cape Hangklip in May.

(b) Rock Lobsters.

Cape rock lobsters were taken by immature seals throughout the day. All had hard shells and some females were in berry (June and September).

By comparison with fish and cephalopods, the rock lobsters formed an insignificant part of the diet of the seals. Their skeletal armour and camouflaged habitat would normally make them difficult prey to catch.

(ii) Prey of Minor Economic Importance.

(a) Fish (see Appendix A).

Anchovies (*Engraulis japonicus*) were only 2 per cent by volume of the fish foods investigated during 1954–56, but are ranked third in importance numerically (see Table 42*a*). They were caught mostly in November. Slightly larger than these fish were others taken by the seals, namely, sandcord (*Gonorhynchus gonorhynchus*) of which two were captured by young seals in False Bay during November; sandeels (*Ammodytes capensis*), taken in numbers in Table Bay and False Bay during October and November, respectively; soles (*Heteromycteris capensis*) and flounders (*Arnoglossus capensis*) in False Bay (October); frogfish (*Chatrabus damaranus*) near Simon's Bay.

(b) Cephalopods.

Octopuses were hunted near the land or in harbours, squid and cuttlefish farther out to sea. Most squid were captured during February, July and November. They were taken at all times of the day.

Octopuses were usually caught singly but traces of up to nine appeared in stomachs examined during 1954–56, and probably refer to a succession of meals off this species. As many as 60 squid may be consumed at one meal but most seals took fewer than this. One sub-adult female seal captured at midday near Cape Point, was actually feeding on small squid and had eaten 53 at the time of her capture. Squid with pens 25 cm. long (weight about 200 gm.) were often found in the seal stomachs but sometimes they were as small as 4 cm. and weighed scarcely 3 gm.

(c) Crustaceans.

Various small crustaceans appeared in the 1954–56 collection of stomachs. Parasitic copepods (*Sphyrion*) and certain isopods presumably came from the fish prey. Thus 26 *Sphyrion* were found in a stomach from St. Helena Bay but no trace of the known hosts such as kingklip or gadoids appeared in this stomach. The parasites probably came from a former meal, having resisted digestion for a long time.

Other crustaceans found in seal stomachs included the following species:—

Decapods.....	*Hymenosoma orbiculare.**
	Ovalipes punctatus.
	Mursia cristimanus.
	Diogenes sp.
	Paguristes sp.
	Megalopa larvae*.
Stomatopoda.....	*Squilla.*
Amphipoda.....	*Parathemistos* sp.
Euphausiacea.....	Unidentified species.
Isopoda.....	*Anilocra* sp.

(iii) Milk.

During the 1954–56 investigation, milk was found in the stomachs of three yearlings captured in July. One stomach held 790 cc., the others 460 cc. and 120 cc., respectively.

Pups are suckled soon after birth and are nursed for nearly a year. They drink strongly as they grow older and can exist without food for as long as 16 days. After a meal of milk the young pup sleeps soundly, sucking again irregularly until the cow leaves the rookery. Yearlings caught by nets during winter sealing, often had empty stomachs due to their habit of sucking when the cows are ashore, digesting the milk rapidly and then spending time in the water while their mothers are at sea.

* Species probably captured by the seal itself.

Older yearlings are gradually forced to forage for themselves or be content with occasional meals of milk.

Not all pups caught by winter sealers have milk in their stomachs. At the start of sealing, netted yearlings include many without milk whereas early clubbing on land gives a catch with much milk in their stomachs. Repeated operations affect the attendance of the cows and nursing may virtually stop. Out of 319 pups expected to have had milk, only 28 actually did and then only in small quantities (see Table 39).

Weaning is a gradual process normally taking place in September or October. It is hastened by the disintegration of the herds after excessive winter sealing. If undisturbed until their eighth or ninth month (July/August), yearlings can withstand the loss of their mothers and adapt themselves well to an independent existence. The transition is difficult for some and loss of weight is high. " Starveling pups " eke out an existence by surreptitious sucking at strange cows but unless they receive sustenance at regular intervals, they seldom survive the rigours of life among a herd of indifferent or even hostile adults. Instances are common of cows suckling their pups until the birth of a new offspring. The old pup may even attempt to drink beside the new one and death of the latter may restore the old relationship between yearling (now a second-year old) and cow. Indeed, a male yearling was nursed for at least 18 months on Sinclair Island.

Seals normally drink milk only in their first year. Black pups feed exclusively on milk until their fourth month (February or March). Thereafter edible and inedible items appear in the stomachs but milk remains the chief one. By their seventh month, yearling-pups indulge in local albeit cursory foraging when the cows are absent. They catch crustaceans, octopuses and small rockfish when playing round the edge of the rookery between nursing periods. A male yearling captured on Geyser Rock in August, showed a fine discrimination in the things it ate, namely, a barbel (*Galeichthys*), a sucker-fish (*Chorisochismus*), three small octopuses, stones, a shell and pieces of seaweed. This diet changes as the young seal moves farther from the shore.

It is considered that no yearling is ever deliberately taught by its parent to catch or hunt special prey. This view is held by observers who have watched mixed parties of seals handling surface fish. But cows have been seen with yearlings in circumstances suggesting that the young become familiar with certain prey by hunting in company with the older animals. The young are able to vary their diet according to age, their experience and the opportunities offered.

(iv) Liquid.

Stomachs opened during the pelagic investigations held varying but generally small amounts of liquid. One stomach with a content-volume of 2,000 cc. had 1,800 cc. of brown fluid in which were mixed the remains of squid and maasbankers. Another stomach with 3,040 cc. of fish and squid, contained 200 cc. of fluid. More liquid appeared in stomachs with freshly-ingested food than in others with only a trace of food. The gastric juices are supplemented by liquid from the body of the prey as well as by seawater taken independently or when the prey is eaten.

In strong contrast to the volume of liquid found in stomachs of feeding seals, was the amount in seals temporarily ashore. Thirty-six per cent (54) bulls killed during the rut held large quantities of clear liquid in their stomachs (see Table 38). Fewer stomachs contained mucus. The fluid (seawater) was deliberately drunk by the animals after disturbance from the summer sealers. Liquid was also found in the stomachs of some July yearlings. One of the latter with an excised stomach weighing 246 gm. had 80 cc. of liquid only; another with a stomach weight of 215 gm. had 40 cc. of liquid. It was never as common in young seals as in old ones.

The normal liquid requirements of seals are thought to be met by the water in their foods. Bishop *et al* (1952) quote the research of Irving and others who found that the true seal, *Phoca vitulina*, loses no water for temperature regulation, the only loss being through the lungs, faeces and urine. Bartholomew & Wilke (1956), however, note that the flipper is an important thermoregulator in the Northern fur seal. Irving and his associates found that saturation of the air of the lungs of *P. vitulina* takes 106 gm. of water; the faeces require 200 gm. water from fish food corresponding to 100 calories. The dependence upon fish foods for water requirements was summed up as follows: " When the seals were fed herrings

which are 80 per cent water, the amount yielding 100 calories (1,250 gm. fish) would contain 1,000 gm. water. By oxidative breakdown, the fat and proteins would yield 121 gm. of metabolic water. Thus, 1,121 minus 306 leaves 815 gm. water for the urine. The food (1,250 gm. herring) would yield urea and salt sufficient to give in 800 ml. of urine a freezing point of –2·7° C (6·3 per cent urea and 1·4 per cent salt)" (Bishop *et al*, 1952).

(v) Other Items in the Stomachs.

Stones.

The presence of stones is discussed in detail below.

Mollusc Shells.

Stomachs from the pelagic collection contained a variety of small molusc shells (*Bullia*, *Macoma*, *Gibbula*, *Burnupena*, etc.). Some had obviously been taken up with stones, others came from the stomachs of the larger prey. It is doubtful whether the shells have any nutritional value.

Feathers.

Sea-bird feathers were found in two stomachs collected at sea during 1954–56. A yearling seal had swallowed a few gannet feathers but a bull had taken feathers and part of the skin of a penguin. The latter seal was captured near Dassen Island when penguins had died in great numbers at the time. It probably mouthed and swallowed remains of the bird floating on the surface.

Insects.

Insects were found in two stomachs of yearlings captured near the shore. Beetles (Coccinellids, Cerambycids and Carabids) and moths had presumably been blown from the land when they were casually taken by the seals.

Seaweed.

Three stomachs held small pieces of soft seaweed.

Miscellaneous Items.

A piece of the stalk of a land plant was found in one stomach, a twist of rope from a lobster net and small pieces of wood in other stomachs.

II. Special Feeding Habits.

(i) Ingestion of Stones.

Young seals pick up and swallow water-worn pebbles and gravel. Stones are present in the stomachs of both sexes of all ages but are more common in the yearlings, being found in 25 per cent of all stomachs considered in Table 46. Only two out of 149 bulls had swallowed stones (see Table 38).

Stones rarely exceed 3 cm. in length and there are never more than 70 in a stomach. The greatest weight was 277 gm. (about ten ounces) for 51 stones; these had a volume of 120 cc., the greatest volume recorded (see Table 47).

Various investigators have claimed that stones serve as ballast when diving (a Cape fur seal yearling with a body-weight of 51 lb. had stones weighing 24 gm. or about 0·1 per cent of its weight). Hamilton (1934) pointed out that stones could well have this function in a top-heavy pup learning to swim for the first time. Stones appeared in the stomachs of Cape fur seal pups in March when two animals were found with a weight of 252 gm. (17 stones) and 26 gm. (8 stones), respectively. The second animal weighed 37½ lb. Both pups were swimming strongly in pods near the rookery.

Stones may crush nematodes (Hahn, 1884), rub stomach ulcers or triturate food. Smith (1927) considered that stones swallowed by the Uruguayan fur seal are picked up with the "octopuses on which the seals feed and which attach themselves tightly to stones on danger of capture." Emery (1941) believed that the function of trituration is the most valid one and cites the handling of stones by seals in zoo tanks. Stones from the bottom of these tanks disappear during feeding but reappear later.

Howell (1930) suggested that stones may serve as "a sort of gastric chewing-gum" to prevent atrophy of the male stomach during the long fast of the mating season. Laws (1955) has emphasised a clear connection between fasting during the moult and rut of the Elephant seal, *Mirounga leonina*, and stones. Only one per cent of Cape fur seal bulls had stones in their stomachs during the rut. Only two out of 37 cows shot on land during the breeding season had swallowed stones.

In the case of the Cape fur seal, stones are obviously related to certain age-groups rather than others. Only two adult seals killed during the pelagic studies were found to contain stones in their stomachs, but among 47 young seals with stones, 43 were yearlings (see Table 49). Most of the latter were caught near the shore; 16 out of 27 stomachs with stones were from yearlings killed on land (see Table 50).

Animals that had ingested stones were not greatly troubled by nematodes which were as frequent in stomachs without stones; nor did they have stomach ulcers. In addition, one cannot reconcile a trituratory function of stones with the presence of milk. The association of stones and other items in 49 stomachs showed that by far the majority of stones were in stomachs with no food at all (see Table 51). Among yearlings killed on land, there was also an overwhelming number with stones only (see Table 52).

Young seals might well ingest stones at definite times of the year. An attempt to decide this is made in Table 53 where 89 per cent of stomachs with stones occurred in August. There were only 25 per cent in October. From known facts about their growth and behaviour, young Cape seals take stones more often in July and August, when they are left without food for several days, than in later months when they are augmenting their milk diet with solid food.

Stones may appease hunger sensations in young pups forced to fast while their mothers are away at sea. They relieve hunger pains in other seals staying near the land for long periods. As an empty stomach contracts considerably, only a few small stones would be needed to counteract hunger.

(ii) Abnormal Feeding Traits.

A bull seal was once reported preying upon penguins at Dyer Island (Annual Report of the Guano Islands Administration, 1937)*, but seals do not normally interfere with these birds which are closely associated with them at all rookeries.

(iii) Food Requirements in Captivity.

Details about their food consumption can be inferred from the maintenance of healthy seals in captivity. Eared seals have lived for many years in zoological gardens where they are a great attraction (*cf.* San Diego Zoo, California). Cape fur seals are admirably displayed at the East London Aquarium and were once kept at the Zoo in Johannesburg. They have also been exhibited in various Zoos in Europe (Schneider, 1942).

Three Cape fur seals at the East London Aquarium are given from 50 to 60 lb. fish daily, in two feeds at 1130 and 1600 SAST. The fish are mostly kabeljou (*Sciaena hololepidota*) and stockfish, but other species are also taken. They are either swallowed whole or torn apart by vigorous shakes of the head (Parkin, *in litt.*).

Detailed experiments on the feeding of seals in captivity were carried out by American biologists at the Woodland Park Zoo in Seattle, U.S.A. Five fur seals were found to have a daily consumption of herrings varying from 6·91 lb. to 9·39 lb. per meal. Food was supplied twice daily at 0830 and 1500 hours (Wilke, *in litt.*).

Dietary studies of other phocids and sea-lions have also given interesting details about the food needs of seals generally. In the Seattle Zoo, a Pacific Harbour seal ate about 15 lb. of fish in two feedings each day. Four sea-lions were fed about 50 lb. per diem in two feedings (Johnson, *in litt.*). The diet of a Harbour seal (body-weight 32 kg.) in the New York Zoo was 819 gm. per diem and a sea-lion (body-weight 273 kg.) was given as 1,856 gm. daily. These animals were all in good condition, not especially fat (Albritton, 1954).

Some years ago the rate of digestion of a captive Californian sea-lion was studied by Dr. V. B. Scheffer who found that ground cork fed in a capsule inside herring was not detected in the faeces for 36½ hours. A red dye appeared in 13 hours possibly by way of the kidneys. Ground charcoal first appeared in 12 hours and disappeared after 17 hours (Scheffer, *in litt.*).

All authorities agree that seals can consume more than their allowance but emphasize that 5 to 15 lb. of fish per diem keeps them healthy. The addition of vitamins has been of great benefit to animals restricted to the somewhat monotonous fish diet. These food allowances (disregarding their composition) may be compared in bulk with mixed feeds of other carnivores in captivity. A male grizzly bear was fed 7,632 gm. daily, a lion was given 3,816 gm. and a Bengal tiger 4,624 gm. daily in the New York Zoo (Albritton, 1954). The oft-expressed contention that seals eat more than their weight in fish every day is not in accordance with the facts of their normal food requirements.

12. Parasites of the Alimentary Canal.

(i) Stomach Nematodes.

Nematodes (*Contracecum osculatum*) were found in 44 per cent of the stomachs examined during 1954–56. Out of 149 bulls examined on Sinclair

* A similar case was reported from Halifax Island (S.W.A.) in 1957.

Island during the rut, 85 per cent had nematodes in their stomachs (see Table 38).

The degree of infestation is usually higher in adult than in young seals. As many as 100 nematodes were found in the stomach of a cow in March, the month of heaviest infestation. Some bulls had more than this but yearlings seldom carried more than 35 nematodes, usually only five or ten.

No mechanical damage to the lining of the stomach was detected but wads of worms in bull stomachs frequently had attachment nodules resembling small ulcers. The nematodes might assist in the breakdown of some food items but this hardly seems necessary in the muscular seal stomach.

The life-cycle of these nematodes is not known; nor is it clear how they synchronise their activities with the feeding habits of the host.

(ii) Intestinal Parasites.

Cestodes (*Diphyllobothrium arctocephalum*) are often found in the large intestine. Their long white proglottids are ejected in the liquid faeces.

An acanthocephalan (*Corynosoma australis*) has also been found in the small intestine but nothing is known of its life-history (Ortlepp, *in litt.*)

13. Seals in Relation to Commercial Fisheries

(i) The Pilchard/Maasbanker Industry.

As the prey of the seal is to a large extent made up of commercially-important fish, any influence that the seals may have in depressing numbers of such prey is considered inimical to man's interests. It has been stated, and is a widely-held opinion, that there are " about 500,000 seals on the coast of the Union . . . the average seal eats between 40 and 50 lb. of fish per day. Seals therefore account for a further 3½ million tons of fish " (Neale-May, 1950).

The significance of this alleged consumption of fish by seals can at present only be understood in relation to trends in the commercial fish catches. The pilchard/maasbanker industry started in 1945 and the catch figures collected in Table 54 show the tremendous growth of this industry, a maximum of 272,600 metric tons in 1952 being the highest catch attained.* The industry was warned against over-exploitation (Annual Report of the Division of Fisheries, 1954) and closed seasons were introduced to safeguard the resource against overfishing. Catch limits of 250,000 tons were fixed but the industry has never reached this quota since 1952.* Nevertheless, returns to date (1955) show no big diminution in the total fish catch.

During the last ten years the industry has taken an increasingly greater number of fish from its operating zone. Because of the efficiency of fishing gear and the numbers of craft involved, the catches obtained in peak years represent an extremely high proportion of catchable fish. If there had been more fish in the fishing zones, they would surely have been caught. But the present difficulty of attaining previous maxima (not reflected in Table 54) led to the contention that the shortfall would be retrieved by preventing seals (and seabirds) from removing catchable fish. Allegations of undesirable competition from the seals implied that the latter were taking fish in commercial quantities, that they were removing more commercial fish than hitherto and that the fish preyed upon by seals could have been taken by commercial fishermen.

As a result of the pelagic studies of 1954–56, it was found that the total seal population in Cape waters is not likely to exceed 50,000 animals. These do not subsist on commercially-important fish only, but eat other marine organisms as well. As a population they consume a large amount of food (*vide* Appendix B) but this is caught over a wide geographical area of at least 7,750 square miles and the catch in a particular locality is small.

Furthermore, the seal population is rigidly controlled† by annual sealing, so much so that some herds have been drastically reduced. Sealing has been a traditional industry on this coast for 300 years.

Seals feed in areas not visited by fishermen and even in the inshore fishing grounds they are few in number. In False Bay, for instance, no seals were seen near pilchard boats operating within a mile of the rookery where deckloads of small fish were obtained without hindrance (1956). There is,

* Except more recently during 1957/58.

† The recent (1957) imposition of quotas, unrelated to actual numbers in the particular herds, may necessitate some other form of control in future.

therefore, little suspicion of direct competition between the lampara-net boats and the seals, any contact being purely random and certainly disregarded by the fishermen. The highly perfected methods of locating fish-shoals and trapping them *en masse* would make foraging by the seals seem at a relatively low level. If pelagic fish are present, locating their whereabouts and effecting their capture should be managed by man far more expeditiously than by the seals.

(ii) Deep-sea Trawling.

Trawlers ply regularly between Table Bay and the fishing grounds near Dassen Island, Slangkop and Cape Point (see Plates V and VI). These vessels bring regular supplies of large demersal fish (stockfish, kingklip) to Cape Town. The otter-trawl technique of fishing down to 300 fathoms makes it unlikely that seals interfere with the nets. Trapped animals may feed on fish entering the cod-end of the net as it is raised to the surface but such instances are rare. The seals usually take fish protruding from the meshes or are attracted to the trawlers by offal thrown overboard.

(iii) Line-fishing.

Line-fishing is a popular past-time in False Bay but many commercial boats rely on the periodical arrival of large migratory fish to make big catches. The line fishermen claim that the large fish are attracted to this bay by smaller fish. This contention led to the promulgation of protective legislation (1956) whereby lampara-net boats were debarred from netting for sale to canneries or reduction plants. The restriction was later amended. In spite of the control measures and the presence of these boats in this bay, good catches of big fish are continually made but the industry is essentially a seasonal one.

Statistical information about the catches landed at False Bay harbours are unfortunately not available and until a method is evolved to gather data about these catches, it is unlikely that trends in this fishery will ever be known accurately. Some fantastic explanations have been publicised about the alleged scarcity of fish in False Bay, seal predation being compared with atom bomb explosions! To ascribe depressive influences to any one agency can be illogical to a surprising degree. It is certain that large fish do not frequent the same places as plentifully as before and the phenomenal catches recorded by Biden (1930) are virtually a thing of the past. Nevertheless, runs of big fish still take place and record catches are occasionally made in False Bay.

Seals frequently harass line-fishing boats during a run of migratory fish. They do this in two ways, by seizing hooked fish as they are pulled up to the boat, or by breaking up shoals encountered by the fishermen. There are seldom more than one or two seals among trolling craft congregated at popular fishing grounds and these animals may easily be dispersed by rifle-fire before they can damage a potential catch.

(iv) Rock Lobster Industry.

The total catch of rock lobsters has shown a slight decrease since 1952 but a high tonnage continues to be landed at various harbours on the West coast (see Table 54). The industry is strictly controlled at the Cape.

Young seals feed upon rock lobsters but there are no records of depredations reaching such a scale as to imperil the industry. Damage to nets or theft of the catch is rare, seals having only a slight nuisance value when they take fish used to bait the nets.

(v) The Guano Industry.

Seals and guano birds have been closely associated for centuries. When man entered this association, links became seasonal ones, guano-collecting in the summer being followed by sealing in the winter. The animal populations of the guano islands have seldom been free from man's interference because of his interests in products derived from their exploitation. In fact, this intrusion originally decimated the animal communities but restored the remnant to a rather precarious position which has only recently been strengthened by an awareness of their inherent weaknesses to exploitation. Because of their sensitivity to man, seals no longer live on islands occupied by man.

There have been periodical fluctuations in the guano harvests (Hutchinson, 1950) but a steady decline has coincided with the growth of the pilchard/maasbanker industry. Too little is known about the effect of increased activity in the fish industry to claim that it is abstracting so great a part of the small fish populations that the birds are being deprived of food normally found close

to the islands, and are thus no longer able to nest successfully. Until it can be shown that internal factors (mostly the cumulative effect of scraping and thus of depressing the surface of an island so as to render progressively more of it unsuitable for nesting) are not restraining the growth of the bird populations, it would be unwise to speculate on the several effects that competition between man, the guano-birds, seals and other fish-eating predators might have on the guano harvest.

(vi) The Sealing Industry.

The sealing industry as a whole shows no decline in catches of seals (see Table 1). The closing of some rocks (Mossel Bay) to private sealers is offset by increased activity at others (*cf.* herds on the mainland south of Luderitz Bay). Market fluctuations in the sale of pelts may affect future growth of the industry which has excellent prospects today. Economic demands should bring about refinements in catch techniques that need not detract from the numbers of seals killed. By seeking to improve the quality of the pelts exported and so creating a greater demand for Cape skins, the industry can cull the herds in such a manner as to ensure that surplus stocks do not encroach on the already overcrowded rocks. By ridding the herds of unproductive animals, management can obviate the commonly heard complaint that bulls should be killed in the summer to decrease the number of seals frequenting fishing areas. It is only by setting a high standard of herd management that rigid protection of the seals can be justified on economic grounds. Without such a standard, conservation deteriorates into a compromise between the ethics of protection and the realities of predation.

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16. Appendix A.

Names of fish eaten by Cape fur seals.

Popular Name.	*Scientific Name.*
Pilchard	*Sardinops ocellata.*
Maasbanker	*Trachurus trachurus.*
Jacopever	*Sebastichthys capensis.*
	Helicolenus maculatus.
Cape mackerel	*Scomber japonicus.*
Stockfish	*Merluccius capensis.*
Hottentot	*Pachymetopon blochii.*
Yellowtail	*Seriola lalandi.*
Silver fish	*Argyrozona argyrozona.*
Dageraad	*Chrysoblephus cristiceps.*
White stumpnose	*Rhabdosargus globiceps.*
Musselcracker	*Cymatoceps nasutus.*
Snoek	*Thyrsites atun.*
Panga	*Pterogymnus laniarius.*
Steenfish	*Chilodactylus fasciatus.*
Cobbler	*Alectis ciliaris.*
Bony fish	*Sparidae.*
Herring-like fish	*Clupeidae.*
Anchovy	*Engraulis japonicus.*
Sole	*Heteromycteris capensis.*
Flounder	*Arnoglossus capensis.*
Frogfish	*Chatrabus damaranus.*
Horsefish	*Congiopodus spinifer.*
Sandeel	*Ammodytes capensis.*
Sandcord	*Gonorhynchus gonorhynchus.*

17. Appendix B.

Estimated Consumption of certain Marine Foods by Cape Fur Seals as based upon Stomachs collected during 1954–56.—

Total population of Cape Seals... 50,000

Total population, excluding seal pups 32,000

Mean amount of food per day: Fish 3 lb.; Cephalopods 1 lb.

Mean number of days feeding per year: 200 days.

Probable amount of food consumed annually = Number of seals × mean daily amount of food × number of feeding days.

	Fish.	*Cephalopods.*
=	$\frac{3 \times 200 \times 32{,}000}{2{,}000}$	$\frac{1 \times 200 \times 32{,}000}{2{,}000}$
=	9,600 short tons.	= 3,200 short tons.

= 12,800 short tons annually.

The average annual consumption of commercial fish:

= 85 per cent of total fish taken

× 8,200 short tons,

of which 80 per cent are pilchards and maasbankers

= 6,600 short tons.

18. Appendix C.

Tables of data on which text, figures and plates are based.

TABLE 2.—Number of Cruises made through certain Reference Areas.

Years.	Reference Areas (see Table 5).							
	1.	2.	3.	4.	5.	5A.	6.	6A.
	Pelagic Studies of 1954–56.							
1954	4	5	6	4	5	—	4	—
1955	3	7	21	13	3	—	1	—
1956	1	8	24	10	8	—	2	—
	Routine Cruises of *Africana II*, 1950–53.							
1950	—	—	—	9	9	9	9	9
1951	—	—	—	12	12	12	12	12
1952	—	—	—	12	12	12	12	12
1953	—	—	—	9	9	9	9	9

TABLE 3.—Monthly Take of Seals during Pelagic Studies of 1954–56.

Month.	Males.			Females.		Total.
	Bulls.	Sub-adults.	Yearlings.	Cows.	Yearlings.	
January	0	1	1	0	1	3
February	1	1	0	15	0	17
March	3	2	3	15	5	28
April	1	0	1	2	0	4
May	0	1	1	3	0	5
June	1	2	3	2	1	9
July	0	2	24	18	21	65
August	2	3	5	9	4	23
September	1	2	3	7	6	19
October	2	4	5	5	7	23
November	2	12	6	5	10	35
December	0	5	2	3	4	14
TOTAL	13	35	54	84	59	245

TABLE 4.—Numbers of Seals taken in Three Main Coastal Areas, 1954–56.

Month.	Lamberts Bay–St. Helena Bay.	Saldanha Bay–Table Bay.	Cape Peninsula–Danger Point.
January	0	0	3
February	0	8	9
March	0	0	28
April	3	0	1
May	0	1	4
June	2	2	5
July	0	8	58
August	1	18	3
September	0	13	6
October	8	5	10
November	6	15	14
December	6	7	1
TOTAL	26	77	142

TABLE 5.—Designated Reference Areas in which Seals were hunted during 1954–56.

Reference Area.	Approximate Size in Square Miles.	General Description.	Position.	
			Latitude S.	Longitude E.
1	350	Walker Bay	34° 38′	18° 48′
			shore	19° 20′
2	350	False Bay	34° 30′	18° 30′
			shore	18° 48′
3	200	Cape Peninsula	33° 52′	18° 16′
			34° 25′	18° 30′
4	1,400	Dassen Island	33° 05′	shore
			33° 52′	17° 45′
5	300	Jacob's Reef	32° 40′	17° 40′
			33° 05′	shore
5A	1,800	West of Columbine	33° 05′	17° 40′
			33° 40′	16° 40′
6	650	St. Helena Bay	32° 00′	shore
			32° 40′	18° 00′
6A	2,700	West of Deseada	32° 00′	16° 40′
			32° 40′	18° 00′

TABLE 6.—Mean Body Measurements of Seals captured on Land during 1948–49.

Class.	Males.						Females.					
	Body Length (cm.)			Body Weight (lb.)			Body Length (cm.)			Body Weight (lb.)		
	Maximum.	Mean.	Minimum.	Maximum.	Mean.	Minimum.	Maximum.	Mean.	Minimum.	Maximum.	Mean.	Minimum.
Black Pups	98	85	67	38	21	5	90	80	65	27	14	6
Yearlings	135	127	111	107	78	48	120	111	99	72	55	38
Sub-adults	190	171	158	227	186	138	147	134	124	118	92	70
Adults	233	215	191	439	379	320	168	156	146	176	144	118
Old Adults	234	223	206	493	413	329	173	161	148	236	165	128

TABLE 7.—Reproductive Status of 144 Female Seals collected at Sea during 1954–56.

Month.	Proestrous.	Pregnant.			Non-pregnant.	
		Nulliparous.	Primiparous.	Multiparous.	Nulliparous.	Senile.
January	—	—	—	—	1	—
February	—	3	2	6	4	—
March	—	2	2	9	7	—
April	—	—	1	1	—	—
May	—	—	—	2	1	—
June	—	—	—	2	1	—
July	—	—	—	12	26	2
August	—	3	—	3	5	2
September	—	—	—	8	5	—
October	—	—	—	5	7	—
November	1	—	—	2	12	—
December	—	—	—	—	7	—

TABLE 8.—Recoveries of Seals branded on Sinclair Island during 1948.

Brand.	Date Branded.	Recovery Data.		
		Date.	Place.	Age/Sex.
47	5/2/48	?/11/55	Cape Cross	Bull.
150	5/3/48	12/11/54	Sinclair Island	Bull.
164	5/3/48	7/12/50	Hollamsbird Island	Young male.
275	26/3/48	7/5/54	20 miles west of Dassen Island	Bull.
		26/9/55	20 miles west of Dassen Island	
		15/10/55	30 miles west of Slangkop	
439	2/9/48	18/6/54	Hollamsbird Island	Bull.

TABLE 9.—Recoveries of Seals tagged on Seal Island (False Bay) during 1954–56.

Tags.	Date Tagged.	Recovery Data.		
		Date.	Place.	Age.
38	4/2/54	4/10/55	Sinclair Island	Two-year old.
359	2/2/55	8/8/55	Cape Cross	Two-year old.
361	2/2/55	1/7/55	Cape Cross	Yearling.
524	2/2/55	?/10/55	Cape Cross	Yearling.
541	2/2/55	8/8/56	Cape Cross	Two-year old.
618	2/2/55	?/5/56	Doornbaai	Two-year old.
711	2/2/55	23/9/56	Sinclair Island	Two-year old.
1,486	19/1/56	?/9/56	Cape Cross	Yearling.
1,607	19/1/56	?/9/56	Cape Cross	Yearling.
1,672	19/1/56	?/9/56	Cape Cross	Yearling.
1,772	19/1/56	?/9/56	Cape Cross	Yearling.
2,081	19/1/56	?/9/56	Cape Cross	Yearling.
2,392	19/1/56	?/9/56	Cape Cross	Yearling.
2,742	19/1/56	5/10/56	Elephant Rock	Yearling.

TABLE 10.—Age and Sex Composition of Seals observed at Sea during 1956.

Month.	Bulls.	Cows.	Sub-adults (Males).	Yearlings of either sex.
January	1	—	5	2
February	2	14	39	3
March	1	6	13	6
April	—	1	1	2
May	—	1	8	—
June	—	2	1	4
July	—	11	16	4
August	4	11	65	17
September	2	14	43	23
October	—	6	62	34
November	9	2	77	29
December	—	—	5	1

TABLE 11.—Recoveries of Seals at various Surface Temperatures (1954–56).

Month.	Surface Temperature in degrees Centigrade.										
	10°	11°	12°	13°	14°	15°	16°	17°	18°	19°	20°
January	1	—	—	—	—	—	—	—	—	—	—
February	—	—	1	5	1	1	—	—	—	—	—
March	—	—	—	—	—	3	2	2	12	8	—
April	—	—	—	3	—	—	—	—	—	—	—
May	—	—	1	—	—	1	—	—	—	—	—
June	—	—	—	1	3	—	—	—	—	—	—
July	—	—	—	5	4	2	3	—	—	—	—
August	—	—	8	11	—	—	—	—	—	—	—
September	—	—	—	—	7	5	—	—	—	—	—
October	2	—	1	2	1	4	—	—	—	—	—
November	—	2	3	5	2	—	2	2	8	—	—
December	—	—	—	—	—	1	2	—	—	—	—

TABLE 12.—Number of Sight Observations of Seals correlated with Wind Force (1951).

Force.	N.	N.N.E.	N.E.	E.N.E.	E.	E.S.E.	S.E.	S.S.E.	S.	S.S.W.	S.W.	W.S.W.	W.	W.N.W.	N.W.	N.N.W.	Total.
Calm	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	20
1	1	—	—	1	—	1	2	—	—	3	2	1	3	1	3	—	18
2	1	—	—	—	1	—	1	2	6	2	1	—	1	2	8	1	26
3	1	—	—	—	—	—	1	1	1	2	1	—	1	—	2	1	11
4	1	1	—	—	—	—	3	2	1	—	1	1	—	—	1	1	12
5	1	—	—	—	—	—	—	1	1	1	—	—	—	—	—	1	5

TABLE 13.—Frequency of Groups of Seals at Sea: Seal-log, 1950.

Number of Individuals in Groups.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	—	—	—	7	11	5	2	4	1	7	5	2
2	—	—	—	4	6	1	—	—	1	3	9	2
3	—	—	—	6	2	—	—	—	2	5	16	3
4	—	—	—	4	3	1	2	1	1	3	12	1
5	—	—	—	2	2	—	—	1	1	1	3	—
6	—	—	—	4	4	3	1	—	4	1	5	—
7	—	—	—	—	—	—	1	—	—	—	2	—
8	—	—	—	—	—	—	1	1	—	1	5	—
9	—	—	—	—	2	—	—	—	—	—	—	—
10	—	—	—	1	1	1	—	—	—	5	2	—
15	—	—	—	—	—	—	—	—	—	—	3	1

TABLE 14.—Frequency of Groups of Seals at Sea: Seal-log, 1951.

Number of Individuals in Groups.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1	4	17	6	6	3	—	3	3	5	6	3
2	3	3	7	5	1	2	—	2	2	5	3	2
3	—	5	10	7	4	1	—	3	3	2	1	—
4	—	1	3	1	—	1	—	—	2	2	1	1
5	2	—	2	3	1	—	—	—	—	10	—	—
6	—	—	2	1	—	1	—	2	2	—	—	—
7	—	1	—	—	—	—	—	—	1	—	—	—
8	1	—	—	1	—	—	—	—	1	—	—	—
9	—	—	—	—	—	—	—	1	1	—	1	—
10	—	1	1	—	—	1	—	1	1	1	—	—
Over 15	—	4	2	2	—	—	—	5	6	7	2	—

TABLE 15.—Frequency of Groups of Seals at Sea: Seal-log, 1952.

Number of Individuals in Groups.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1	2	14	3	1	4	4	8	17	4	7	—
2	1	2	1	—	1	3	—	—	3	6	1	—
3	—	1	3	1	1	3	—	—	5	—	3	—
4	—	1	—	—	—	1	—	—	—	—	5	—
5	—	3	3	1	1	2	—	—	—	—	—	—
6	—	1	1	—	1	—	—	—	1	3	1	—
7	—	—	—	—	—	—	—	—	—	—	—	—
8	—	1	1	—	—	—	—	—	1	—	2	—
9	—	—	1	1	—	—	—	—	—	—	—	—
10	—	—	—	—	—	1	—	—	—	—	—	—
Over 15	—	4	2	1	2	3	3	3	—	2	1	2

TABLE 16.—Frequency of Groups of Seals at Sea: Seal-log, 1953.

Number of Individuals in Groups.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	3	3	6	—	2	2	1	—	—	—
2	—	2	1	2	1	2	—	—	—	—
3	1	—	1	—	—	1	—	—	—	—
4	1	1	—	—	1	2	—	—	—	—
5	1	—	1	—	3	3	1	2	—	—
6	1	1	—	—	—	—	—	—	—	—
7	—	—	—	—	—	—	—	—	—	—
8	—	—	—	—	—	1	—	—	—	—
9	—	—	—	—	—	—	—	—	1	—
10	—	—	—	—	3	2	2	1	—	—
Over 15	—	5	2	1	2	5	4	1	—	—

TABLE 17.—Occurrence of Groups of over Fifteen Seals at Sea: Seal-log, 1950.

Month.	Table Bay–Dassen Island.	Dassen Island–Saldanha Bay.	Saldanha Bay–Cape Columbine.	Stompneus Bay–Cape Deseada.
January	—	—	—	—
February	—	—	—	—
March	—	—	—	—
April	—	1	2	—
May	—	—	—	—
June	—	—	1	—
July	—	—	2	—
August	—	—	—	—
September	—	—	—	—
October	1	—	1	—
November	—	—	3	—
December	1	—	1	—

TABLE 18.—Occurrence of Groups of over Fifteen Seals at Sea: Seal-log, 1951.

Month.	Table Bay–Dassen Island.	Dassen Island–Saldanha Bay.	Saldanha Bay–Cape Columbine.	Stompneus Bay–Cape Deseada.	Cape Deseada–Lambert's Bay.
January	—	—	—	—	—
February	3	1	—	—	—
March	2	—	—	—	—
April	—	1	1	—	—
May	—	—	—	—	—
June	—	—	—	—	—
July	—	—	—	—	—
August	2	—	2	—	1
September	1	2	2	—	1
October	—	1	4	2	—
November	—	—	—	—	2
December	—	—	—	—	—

TABLE 19.—Occurrence of Groups of over Fifteen Seals at Sea: Seal-log, 1952.

Month.	Table Bay–Dassen Island.	Dassen Island–Saldanha Bay.	Saldanha Bay–Cape Columbine.	Stompneus Bay–Cape Deseada.	Cape Deseada–Lambert's Bay.
January	—	—	—	—	—
February	—	1	3	—	—
March	—	—	2	—	—
April	—	—	—	1	—
May	—	—	2	—	—
June	—	—	2	1	—
July	—	—	2	1	—
August	2	1	—	—	—
September	—	—	—	—	—
October	1	—	—	—	1
November	—	—	—	—	1
December	—	1	1	—	—

TABLE 20.—Occurrence of Groups of over Fifteen Seals at Sea: Seal-log, 1953.

Month.	Table Bay–Dassen Island.	Dassen Island–Saldanha Bay.	Saldanha Bay–Cape Columbine.	Stompneus Bay–Cape Deseada.	Cape Deseada–Lambert's Bay.
January	—	—	—	—	—
February	1	1	—	—	3
March	1	—	1	—	—
April	—	1	—	—	—
May	1	—	1	—	—
June	—	1	1	3	—
July	2	1	1	—	—
August	—	—	1	—	—
September	—	—	—	—	—
October	—	—	—	—	—
November	—	—	—	—	—
December	—	—	—	—	—

TABLE 21.—Numbers of Seals sighted at Sea in all Study Areas.

	Seal-log, 1950–53.				Pelagic Studies, 1954–56.		
	1950.	1951.	1952.	1953.	1954.	1955.	1956.
Annual total	1,240	1,808	1,729	1,134	118	237	855
Highest monthly total for each year	261	503	367	276	34	60	81
Monthly average for each year	138	164	144	142	19	26	71
Lowest monthly total for each year	59	11	3	22	1	0	0
Number of months of observation	9	11	12	8	6	9	12
Highest monthly average for whole period	269 (October).				211 (October).		
Monthly average for whole period	154				100		
Lowest monthly average for whole period	17 (January).				19 (January).		

TABLE 22.—Monthly Records of Seals at Sea in all Areas: Seal-log, 1950–53.

Month.	1950.		1951.		1952.		1953.		Monthly Average.
	Total for Month.	Percent. of Yearly Total.	Total for Month.	Percent. of Yearly Total.	Total for Month.	Percent. of Yearly Total.	Total for Month.	Percent. of Yearly Total.	
January.....	—	—	25	1·5	3	0·2	22	2·0	17
February....	—	—	92	5·2	367	21·2	190	17·0	216
March.....	—	—	170	9·4	101	6·0	208	18·2	159
April.....	103	8·1	156	8·7	255	15·0	37	3·6	184
May.....	132	10·6	37	2·2	96	8·5	132	11·2	99
June.....	59	4·8	81	4·5	147	11·1	276	24·5	141
July.....	191	15·4	—	—	202	9·1	196	17·3	196
August.....	24	1·9	213	11·8	169	5·2	73	6·2	119
September...	81	6·7	394	21·2	91	8·0	—	—	189
October.....	167	13·5	503	27·8	139	8·0	—	—	269
November...	261	21·0	126	7·1	138	1·2	—	—	175
December....	222	18·0	11	0·6	21	5·5	—	—	85

TABLE 23.—Monthly Records of Seals at Sea—Pelagic Studies, 1954–56.

Month.	Areas in which the Following Numbers of Seals were sighted.														
	1.			2.			3.			4.			5.		
	1954.	1955.	1956.	1954.	1955.	1956.	1954.	1955.	1956.	1954.	1955.	1956.	1954.	1955.	1956.
January..	—	—	—	—	8	8	—	1	2	—	—	—	—	—	—
February.	—	—	—	—	—	*	—	—	1	—	—	73	—	—	—
March....	—	—	—	—	—	—	—	—	8	—	—	—	—	—	—
April.....	—	—	—	—	3	—	—	1	—	—	1	—	—	—	8
May.....	—	2	1	—	*	3	—	1	9	—	1	—	—	—	—
June.....	—	2	—	—	—	—	—	—	16	—	1	—	—	—	—
July.....	—	—	—	—	—	18	—	—	17	—	—	51	—	—	2
August...	—	—	1	—	—	24	—	—	29	—	—	*	4	—	—
September	1	—	16	—	—	23	3	4	20	1	5	*	—	—	30
October..	1	—	—	4	*	18	—	27	21	3	21	51	—	—	23
November	—	—	—	—	13	45	—	42	17	—	9	40	—	—	27
December	—	—	—	1	—	—	*	4	5	—	—	2	—	—	—

* Denotes seals too numerous to be accurately counted.

TABLE 24.—Monthly Records of Seals in various Reference Areas—Seal-log, 1950–53.

Month.	Areas in which the following Numbers of Seals were sighted.														
	4.			5.			5A.			6.			6A.		
	1950.	1951.	1952.	1950.	1951.	1952.	1950.	1951.	1952.	1950.	1951.	1952.	1950.	1951.	1952.
January..	—	1	—	—	7	—	—	2	—	—	2	1	—	5	2
February.	—	42	25	—	11	247	—	—	20	—	19	1	—	0	20
March....	—	91	4	—	33	60	—	4	—	—	—	7	—	38	15
April.....	40	57	—	60	63	8	—	—	—	—	1	—	—	20	229
May.....	83	18	21	7	1	57	1	6	—	42	3	—	2	1	5
June.....	21	62	20	2	14	40	—	—	—	9	1	—	15	—	70
July.....	1	—	2	161	—	160	—	—	1	—	—	—	4	—	37
August...	3	92	161	12	38	—	—	20	—	—	52	—	9	—	8
September	10	65	24	6	71	16	1	—	—	6	27	3	12	165	10
October..	35	59	8	24	239	—	58	—	3	2	169	—	15	—	24
November	52	11	9	204	11	66	11	38	1	3	—	—	35	2	—
December	25	—	1	190	—	12	—	—	—	3	—	—	3	—	—

TABLE 25.—Average Number of Seals in various Reference Areas—Seal-log, 1950–53.

Month.	Areas in which the following Three-year monthly Averages were found.				
	4.	5.	5A.	6.	6A.
January.....	1	7	2	3	7
February.....	67	258	20	20	20
March.....	95	93	4	7	53
April.....	97	131	—	1	259
May.....	102	65	7	45	8
June.....	103	56	—	10	85
July.....	3	320	1	—	41
August.....	255	50	20	52	17
September.....	99	94	1	36	187
October.....	102	263	61	171	39
November.....	72	281	50	3	37
December.....	26	202	—	3	3

TABLE 26.—Density of Seals at Sea in Relation to the Number of Cruises undertaken during 1956.

	Reference Areas.					
	1.	2.	3.	4.	5.	6.
Number of cruises.....	1	8	24	10	8	2
Total number of seals sighted.....	18	139*	145	217*	90	14
Number of seals sighted on each cruise.....	18	15*	6	22*	11	7
Total area in square miles.....	350	350	200	1,400	300	650
Number of seals per square mile.....	0·05	0·4*	0·7	0·15*	0·03	0·01

* Denotes additional seals that could not be counted accurately.

TABLE 27.—Winter Sealing Catch from Cape Rookeries—Yearling Seals.

	Quoin Rock.	Geyser Rock.	Seal Island.	Robbe-steen.	Jacob's Reef.	Elephant Rock.
Catch in 1954	—	2,064	1,334	—	—	873
Catch in 1955	—	1,570	3,363	(12)	—	916
Catch in 1956	(3)	1,101	4,036	—	—	—
Maximum catch	523	5,650	4,036	1,766	1,110	1,869
Average catch	113	2,806	2,249	616	609	1,068
Minimum catch	(3)	1,101	260	(12)	181	179
Number of annual operations	8	21	4	7	3	9
Capacity of Seal Rock (pups)	654	7,062	5,045	2,208	1,387	2,336
Catch potential	622	6,709	4,793	2,098	1,318	2,225

TABLE 28.—Total Number of Seals killed before and after 1945—Western Cape only.

	Decade 1935–1945.						Decade 1946–1956.					
	Quoin Rock.	Geyser Rock.	Seal Island.	Robbe-steen.	Jacob's Reef.	Ele-phant Rock.	Quoin Rock.	Geyser Rock.	Seal Island.	Robbe-steen.	Jacob's Reef.	Ele-phant Rock.
Winter	627	27,128	—	3,826	?	812	310	31,809	9,001	486	1,926	8,206
Summer	839	5,012	—	—	—	—	3,993	4,032	—	—	—	5,825
Grand Total..	Winter 32,393 yearlings. Summer 5,851 bulls.						Winter 51,738 yearlings. Summer 13,850 bulls.					

TABLE 29.—Summer Sealing Catch from Cape Rookeries—Bull Seals.

	Quoin Rock.	Geyser Rock.	Seal Island.	Robbe-steen.	Jacob's Reef.	Elephant Rock.
Catch in 1954	—	728	—	—	—	1,027
Catch in 1955	259	—	—	—	—	—
Catch in 1956	—	—	—	—	—	—
Maximum catch	742	1,135	—	—	—	1,105
Average catch	592	695	—	—	—	832
Minimum catch	259	140	—	—	—	84
Number of annual operations	8	13	—	—	—	7
Capacity of Seal Rock (bulls)	742	1,135	—	—	—	1,105

TABLE 30.—Numbers of Seals counted on Aerial Photographs of Cape Rookeries.

	Quoin Rock.	Geyser Rock.	Seal Island.	Duiker-klip.	Robbe-steen.	Jacob's Reef.
October—						
Bulls	80	?	164	95	—	95
Others	2,250	523	3,014	8	—	2,500
November—						
Bulls	230	612	1,252	245	139	217
Others	813	2,462	7,789	281	1,528	?

TABLE 31.—Length of Stay on Land by Adult Males (Sinclair Island).

	Reference Numbers of Marked Bulls.					
	"G".		"285".		"A".	
	Days on Land.	As per cent of Month.	Days on Land.	As per cent of Month.	Days on Land.	As per cent of Month.
August	6	19·2	6	19·2	—	—
September	8	26·6	10	33·4	—	—
October	13	44	6	19·2	—	—
November	18	60	—	—	—	—
December	12	38·7	—	—	22	70·9
January	—	—	—	—	12	38·7
February	—	—	—	—	14	50

TABLE 32.—Length of Stay on Land of Normal Lactating Cows (Sinclair Island).

Consecutive 30-day Periods after Parturition.	Reference Numbers of Marked Cows.					
	"603".		"604".		"613".	
	Days on Land.	As per cent of Period.	Days on Land.	As per cent of Period.	Days on Land.	As per cent of Period.
1	17	56·7	22	73	22	73
2	19	63·4	16	53·4	17	57
3	18	60	13	43·4	13	43·4

TABLE 33.—Length of Stay on Land of Cows suckling a Previous Litter.

Consecutive 30-day Periods before and after Parturition.	Reference Number of Marked Cows.			
	"L".		"251".	
	Days on Land.	As per cent of Period.	Days on Land.	As per cent of Period.
Prepartum—				
1	10	33·4	8	26
2	10	33·4	8	26
3	6	20	10	33·4
Post-partum—				
1	20	66·7	14	47
2	17	57	13	43·4
3	15	50	14	47

TABLE 34.—Length of Stay on Land of Unemployed (non-lactating) Cows.

Consecutive 30-day Periods after the Birth of the Pup.	Reference Number of Marked Cows.					
	"432".		"471".		"562".	
	Days on Land.	As per cent of Period.	Days on Land.	As per cent of Period.	Days on Land.	As per cent of Period.
1	9	30	11	36·7	2	6·7
2	5	16·7	11	36·7	12	40
3	8	26·7	6	20	12	40

TABLE 35.—Length of Stay on Land of Three-year Old Seals.

Month.	Males.	Females.
	Average time on land for 5 marked seals.	Average time on land for 4 marked seals.
	days.	days.
December	4·6	6·8
January	8·6	10·7
February	4·7	3·0

TABLE 36.—Analysis of Contents of 366 Stomachs of Seals killed on Sinclair Island.

Suture class.	Total number of stomachs.	Number of stomachs without food/stones.	Number of stomachs with following items.				
			Stones.	Fish.	Cephalopod.	Crustacean.	Milk.
			Females.				
B	20	12	5	—	2	4	3
C	14	14	1	—	—	—	—
D	27	22	2	3	2	—	—
E	15	12	2	1	1	1	—
F	15	13	2	1	2	1	—
G	15	11	—	3	2	—	—
H	3	3	—	—	—	—	—
J	8	8	1	—	1	—	—
K	24	22	1	1	1	—	—
L	14	12	—	2	—	—	—
M	17	17	—	—	—	—	—
Others	24	24	—	—	—	—	—
			Males.				
B	18	7	8	2	3	8	2
C	35	33	2	2	1	—	—
D	21	20	1	1	—	—	—
E	21	19	—	1	2	—	—
F	8	7	1	—	—	—	—
G	20	19	—	1	—	—	—
H	11	10	—	—	1	—	—
J	20	18	—	—	2	—	—
K	8	8	1	—	—	—	—
L	6	5	—	1	1	—	—
TOTAL	366	315	27	19	21	14	5

TABLE 37.—Contents of 24 Stomachs of Seals killed on Sinclair Island, 1948.

Reference.	Age/Sex.	Weight of contents.	Volume of contents.	Number of stones.	Numbers of the following items.		
					Cephalopods.	Fish.	Crustaceans.
January:							
2753	Adult female.	155	66	10	3 Unidentified.	—	1 Isopod.
2759	Adult female.	125	50	8	1 Unidentified.	—	—
2770	Adult female.	70	25	4	—	—	—
2792	2-year female	128	46	22	—	—	—
2804	2-year female	68	25	4	—	—	—
February:							
2808	Adult female.	320	320	—	—	9 Pilchards....	—
2815	Adult female.	1,195	512	11	—	12 Pilchards....	—
2820	Adult female.	205	76	32	1 *Sepia* sp.....	—	2 Rock lobsters.
March:							
2860	Adult female.	15	15	—	1 Unidentified.	1 Mackerel	—
2868	Adult female.	29	25	—	1 Unidentified.	unidentified	—
August:							
2920	1-year female	55	28	12	—	—	1 Rock lobster.
September:							
1713	1-year male..	156	25	5	—	—	—
1725	1-year female	48	35	34	—	—	1 Crab.
October:							
1922	1-year male..	200	75	27	Unidentified....	—	1 Rock lobster. 6 Shrimps.
November:							
2029	1-year male..	30	30	—	1 Unidentified.	—	1 Rock lobster.
2032	1-year male..	260	450	—	—	—	21 Rock lobsters.
2045	Adult male...	110	50	7	19 Unidentified.	—	—
2076	1-year male..	208	—	—	—	—	10 Rock lobsters. 2 Crabs.
2137	1-year male..	110	70	—	2 Unidentified.	—	—
December:							
2497	Adult female.	139	150	—	—	5 Pilchards....	—
2633	Adult male...	65	52	—	—	72 Maasbankers	—
2681	1-year male..	25	20	—	2 *Sepia* sp.....	1 Snoek.....	1 Rock lobster.
2691	2-year male..	170	70	55	—	—	—
3044	1-year female.	110	40	12	—	—	—

TABLE 38.—Contents of Stomachs of 149 Bull Seals killed on Land (1946–47).

Month.	Total Number of Stomachs.	Number of Stomachs without Fluid or Food.	Number of Stomachs containing the following Items.					
			Fluid.	Mucus.	Cephalopods.	Fish.	Stones.	Nematodes.
October.....	22	9	9	2	2	2	1	20
November.....	127	41	45	33	12	3	1	107

TABLE 39.—Contents of Stomachs of 319 Yearling Seals killed on Land (1946–47).

Month.	Total number of stomachs.	Number of stomachs with no food.	Number of stomachs containing the following items.					
			Stones.	Milk.	Crustaceans.	Fish.	Cephalopods.	Seaweed.
July	28	2	25	2	1	—	—	1
August	271	73	181	18	5	2	1	1
September	20	10	—	8	—	1	—	—

TABLE 40.—Occurrence of various Items in Stomachs of 245 Seals killed at Sea during 1954–56.

Number of Stomachs with Volume of Food more than 10 cc.	Number of Stomachs with Volume of Food less than 10 cc.	Number of Stomachs with Stones only.	Number of Stomachs without Food or Stones.
135	22	34	54

TABLE 41.—Frequency of Occurrence of Food Items in 245 Stomachs of Seals killed at Sea during 1954–56.

Nature of Food.	Number of Stomachs in which the following Items or their Combinations appeared.
Fish only	58
Fish and cephalopods only	48
Fish, cephalopods and crustaceans	16
Cephalopods only	13
Cephalopods and crustaceans only	6
Crustaceans only	7
Crustaceans and fish only	2

TABLE 42A.—Frequency of Occurrence of Fish in 245 Stomachs of Seals killed at Sea during 1954–56.

Items.	Number of items in all stomachs.	Number of stomachs with each item.	Occurrence as percent. of total stomachs with food group. (124).	Occurrence as percent. of total stomachs with food (157).
Maasbankers	1,058	63	50·8	40·1
Pilchards	460	35	28·3	22·2
Anchovies	128	6	4·8	3·8
Stockfish	9	5	4·0	3·1
Jacopevers	29	3	2·4	1·8
Soles	24	3	2·4	1·8
Cape mackerel	3	3	2·4	1·8
Hottentot	11	3	2·4	1·8
Yellow-tail	2	2	1·6	1·2
Sandcords	150	2	1·6	1·2
Flounders	6	2	1·6	1·2
Steenfish	2	2	1·6	1·2
Sandfish	2	2	1·6	1·2
Silverfish	4	1		
Cobbler	1	1		
Frogfish	36	1		
White stumpnose	4	1		
Musselcracker	2	1	1·0	1·0
Horsefish	1	1		
Dageraad	1	1		
Snoek	1	1		
Panga	1	1		
Clupeids	—	4	3·2	2·5
Elasmobranchs	—	4	3·2	2·5
Sparids	—	2	1·6	1·2
Unidentified	—	20	16·1	12·7

TABLE 42B.—Frequency of Occurrence of Items other than Fish, in 245 Stomachs of Seals killed at Sea during 1954–56.

Items.	Number in all stomachs.	Number of stomachs with each item.	Occurrence as percent. of all stomachs with food group.	Occurrence as percent. of all stomachs with food.
Cephalopods—				
Loligo sp.	484	64	77·1	40·8
Octopus sp.	81	21	25·3	13·4
Sepia sp.	12	10	12·0	6·3
Unidentified	—	6	7·2	3·8
Crustaceans—				
Cape rock lobsters	12	10	32·2	6·3
Isopods	—	3	9·6	1·8
Crabs	5	5	16·1	3·1
Paguriste	1	1	3·2	—
Diogenes	2	1	3·2	—
Sphyrion	28	3	9·6	1·9
Euphausiids	—	1	3·2	—
Unidentified	7	10	32·2	6·3
Milk	—	4	—	2·5
Stones	706	49	—	—
Other—				
Shells	—	10	—	—
Insects	—	2	—	—
Feathers	—	2	—	—
Rope	—	1	—	—
Seaweed	—	1	—	—
Wood	—	1	—	—

TABLE 43.—Analysis of 135 Stomachs* of Seals captured at Sea during 1954–56.

Total volume of all edible items including liquid.	Total volume of the fish.	Total volume of the cephalopods.	Total volume of the crustaceans.	Total volume of milk.
161,681 cc.	108,946 cc.	33,219 cc.	3,146 cc.	1,667 cc.

* Volume of food in each stomach more than 10 cc.

TABLE 44.—Volume of major Food Items in 245 Stomachs of Seals killed at Sea during 1954–56.

Items.	Volume in all stomachs (cc.).	Volume as percent. of group volume.
Cephalopods—		
Loligo sp.	9,412	28·3
Octopus sp.	22,993	69·3
Sepia sp.	814	2·4
Fish—		
Maasbanker	64,265	58·9
Pilchard	20,808	18·9
Anchovy	2,207	2·1
Jacopever*	4,000	3·6
Jacopever†	1,020	0·9
Sandcord	905	0·8
Cape Mackerel	245	0·2
Stockfish	2,200	2·1
Hottentot	2,510	2·3
Yellowtail	1,150	1·0
Frogfish	1,300	1·1
Soles	700	0·6
Flounders	275	0·2
Silverfish	650	0·6
Cobbler	600	0·6
Steenfish	335	0·3
White stumpnose	50	—
Mussel-cracker	250	0·2
Horse-fish	100	0·1
Dageraad	200	0·2
Snoek	200	0·2
Sandfish	trace	—
Panga	trace	—
Clupeids	990	0·9
Elasmobranchs	900	0·8
Sparids	602	0·6
Unidentified	2,453	2·3
Crustaceans—		
Cape rock lobsters	3,096	98·5
Isopods	50	1·5

* *Sebastichthys.* † *Helicolenius.*

TABLE 45.—Monthly Analysis of the Volume of major Food Items and Stones in 245 Stomachs of Seals collected at Sea during 1954–56.

Month.	Total Volume (cc.).	Fish.		Cephalopods.		Crustaceans.		Stones.	
		Volume.	Per cent.	Volume.	Per cent.	Volume.	Per cent.	Volume.	Per cent.
January.....	1,650	483	30	1,139	70	—	—	10	0·6
February....	23,290	21,938	94	543	2	—	—	—	—
March.....	33,850	31,670	94	460	1·8	—	—	—	—
April.....	18,540	5,075	27	13,410	72	—	—	30	0·1
May.....	5,050	3,666	72	812	16	—	—	80	1·5
June.....	5,050	3,855	75	49	0·9	100	2	40	0·8
July.....	12,954	5,800	44	3,458	26	50	0·4	1,097	8·4
August.....	16,630	11,118	66	3,500	21	430	2	10	0·1
September...	5,657	2,703	48	2,335	41	466	8	13	0·2
October.....	18,095	7,348	40	5,140	28	1,770	9	22	0·1
November...	15,545	10,010	64	2,373	15	330	2	—	—
December....	5,370	5,280	87	—	—	—	—	—	—

TABLE 46.—Presence of Stones in Stomachs of Seals: Summary.

Source.	Number of Stomachs.	Number of Stomachs with Stones.					
		Adults.		Sub-adults.		Yearlings.	
		Number.	Per cent.	Number.	Per cent.	Number.	Per cent.
Table 36.....	366	7	1·9	4	1·0	16	4·3
Table 38.....	149	2	1·3	—	—	—	—
Table 39.....	319	—	—	—	—	206	64·5
Table 42B.....	245	2	0·8	4	1·6	43	17·5
Total.....	1,079	11	1·0	8	0·7	265	24·5

TABLE 47.—Data about Stones from 49 Stomachs of Seals killed at Sea during 1954–56.

	Total weight of stones in any stomach (gm.).	Total volume of stones in any stomach (cc.).	Number of stones in any stomach.	Number of stones less than 1 cm. in any stomach.	Number of stones more than 1 cm. in any stomach.
Maximum.....	277	120	72	55	35
Mean.....	65·2	32	14·2	13·8	13
Minimum.....	1	1	1	1	1
Number of stomachs.....	49	38	49	10	13

TABLE 48.—Data about Stones in 17 Stomachs of Seals killed on Land (1947–49).

	Total weight of stones in any single stomach. (gm.).	Total volume of stones in any single stomach. (cc.).	Number of stones in any single stomach.
Maximum	205	68	55
Mean	96·4	37·7	15·2
Minimum	1	1	1

TABLE 49.—Presence of Stones in 49 Stomachs of Seals according to Age and Sex.

Age.	Males.	Females.
Adult	2	0
Sub-adult	4	0
Yearling	19	24

TABLE 50.—Presence of Stones in 27 Stomachs of Seals according to Age and Sex.

Age.	Males.	Females.
Adult	1	6
Sub-adult	2	2
Yearling	10	6

TABLE 51.—Stones in relation to other Items in 49 Stomachs of Seals killed at Sea during 1954–56.

Stones only	34
Stones and cephalopods	1
Stones, cephalopods and fish	4
Stones, cephalopods, fish and crustaceans	1
Stones, cephalopods and crustaceans	1
Stones, fish and shells	1
Stones and fish	2
Stones and crustaceans	1
Stones and milk	3
Stones and shells	1
Stones and nematodes	3

TABLE 52.—Stones and other Items in 200 Stomachs of young Seals examined at Dyer Island during 1946.

Item or combination of items.	number of stomachs.
Stones only	136
Stones and milk	3
Stones and crustaceans	1
Stones and cephalopods	1
Milk only	7
Crustaceans only	1
Empty stomachs	51

TABLE 53.—Seasonal Occurrence of Stones in Stomachs of Yearling Seals.

Month.	Yearlings killed at sea.			Yearlings killed on land.		
	Number examined.	Number with with stones.	Percent. with stones.	Number examined.	Number with with stones.	Percent. with stones.
June	4	—	—	—	—	—
July	45	32	71	28	25	89
August	9	8	89	275	182	65
September	9	3	34	33	3	9
October	12	3	25	3	0	0
November	16	0	0	13	3	23
December	6	0	0	4	1	25

TABLE 54.—Catch Statistics of Marine Animals for the Union of South Africa.*

Year.	Catch Statistics (Thousands of metric tons).						Seals.†
	Pilchards.	Maas-bankers.	Stockfish.	Kingklip.	Snoek.	Cape lobsters.	
1949	70·0	30·0	28·5	1·3	11·5	11·3	3,900
1950	108·9	36·3	35·7	1·2	12·5	12·7	7,810
1951	99·4	101·0	44·4	1·7	13·5	13·6	9,760
1952	170·0	102·6	44·1	2·0	13·2	13·6	6,076
1953	137·0	84·5	46·4	1·9	14·0	13·6	5,104
1954	88·3	118·1	52·3	1·4	13·2	12·2	6,026
1955	122·0	78·8	55·3	1·4	13·6	12·2	6,025

* F.A.O. Report, 1954/55. † Government catches only.

TABLE 55.—Percentage Catch of Pilchards and Maasbankers according to Length.

Length groups. cm.	Seal.				Gannet.			
	Pilchards.		Maasbankers.		Pilchards.		Maasbankers.	
	Per cent. of total.	Number of fish.	Per cent. of total.	Number of fish.	Per cent. of total.	Number of fish.	Per cent. of total.	Number of fish.
0– 5..	—	—	2	12	30	59	18	69
6–10..	19	16	1	10	6	11	62	235
11–15..	—	—	18	134	33	64	17	63
16–20..	41	35	67	499	22	42	1·5	6
21–25..	29	25	8	63	9	15	1·5	5
26–35..	11	8	4	27	—	—	—	—

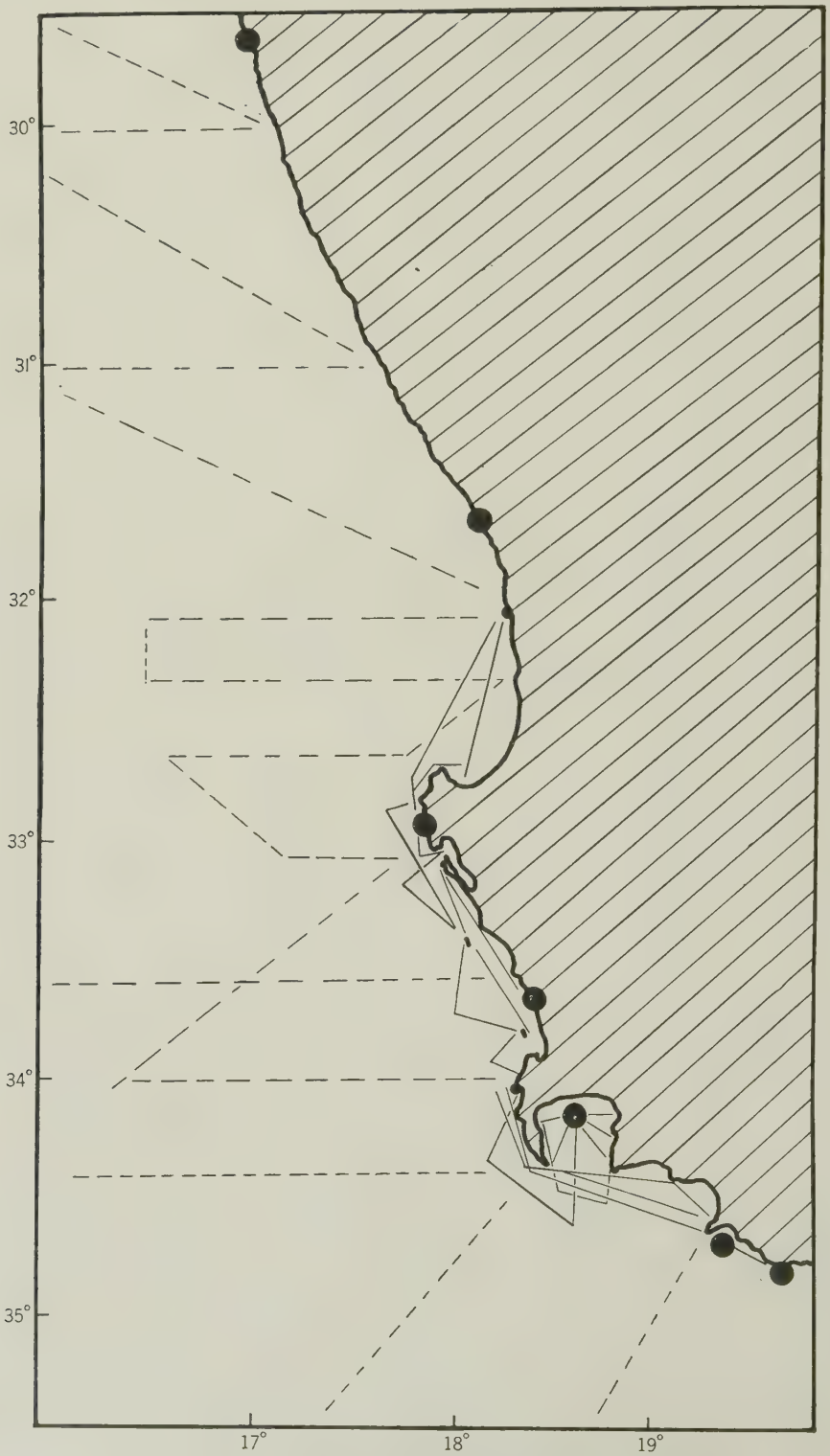


PLATE 1.. ROUTINE CRUISES FOR THE RESEARCH SHIPS.

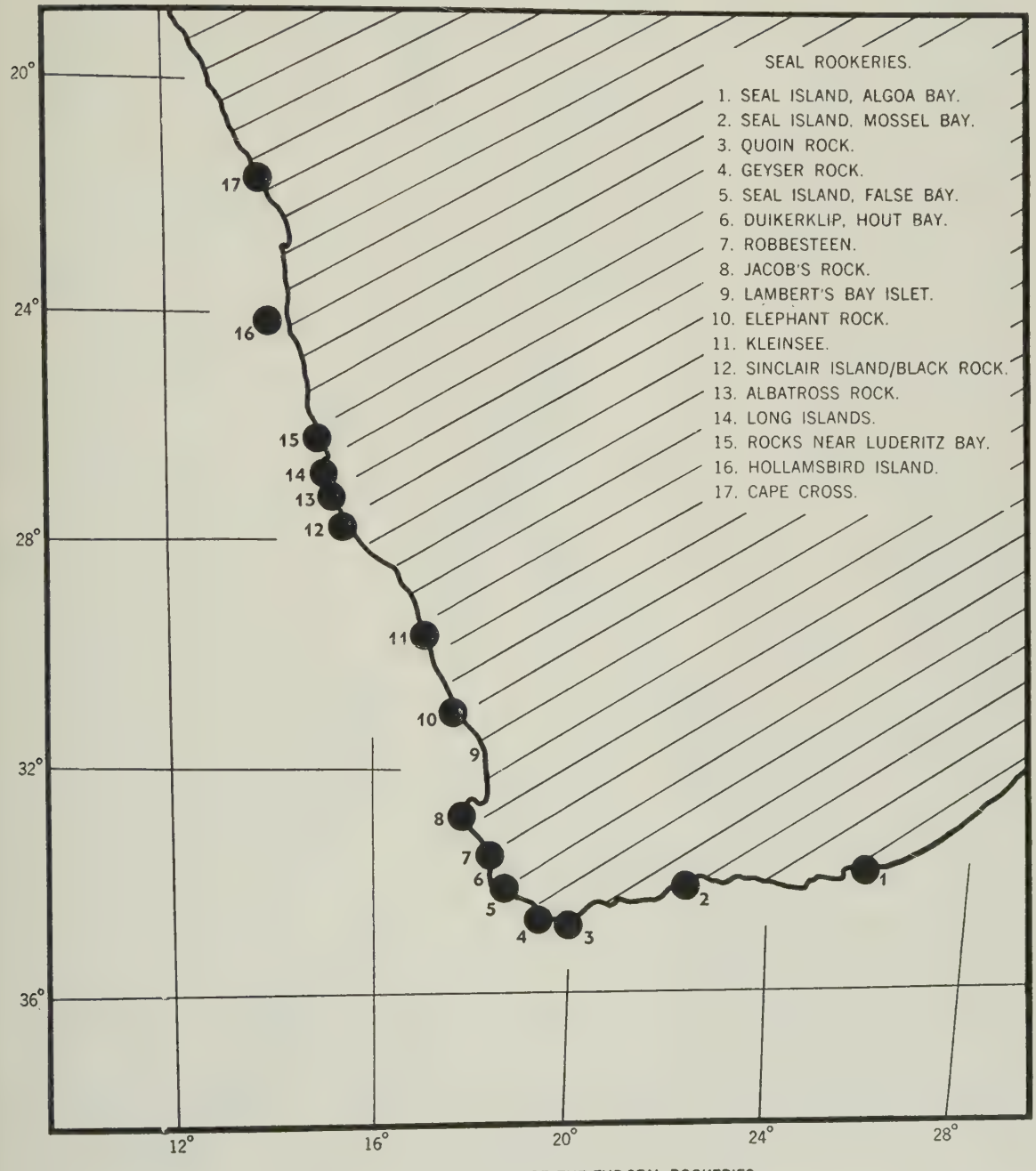


PLATE II LOCATION OF THE FUR-SEAL ROOKERIES.

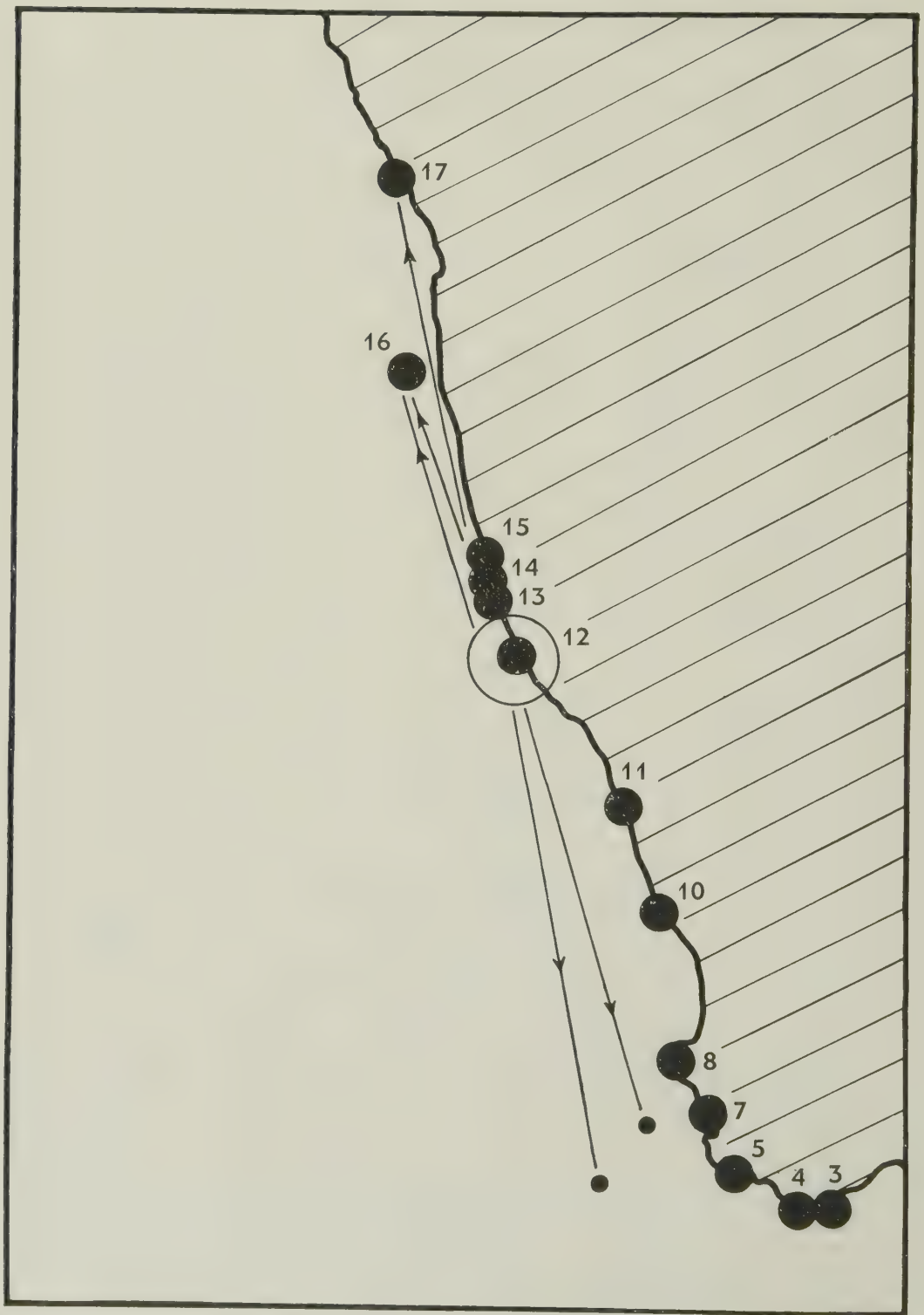


PLATE III. RECOVERIES OF BRANDED SEALS.

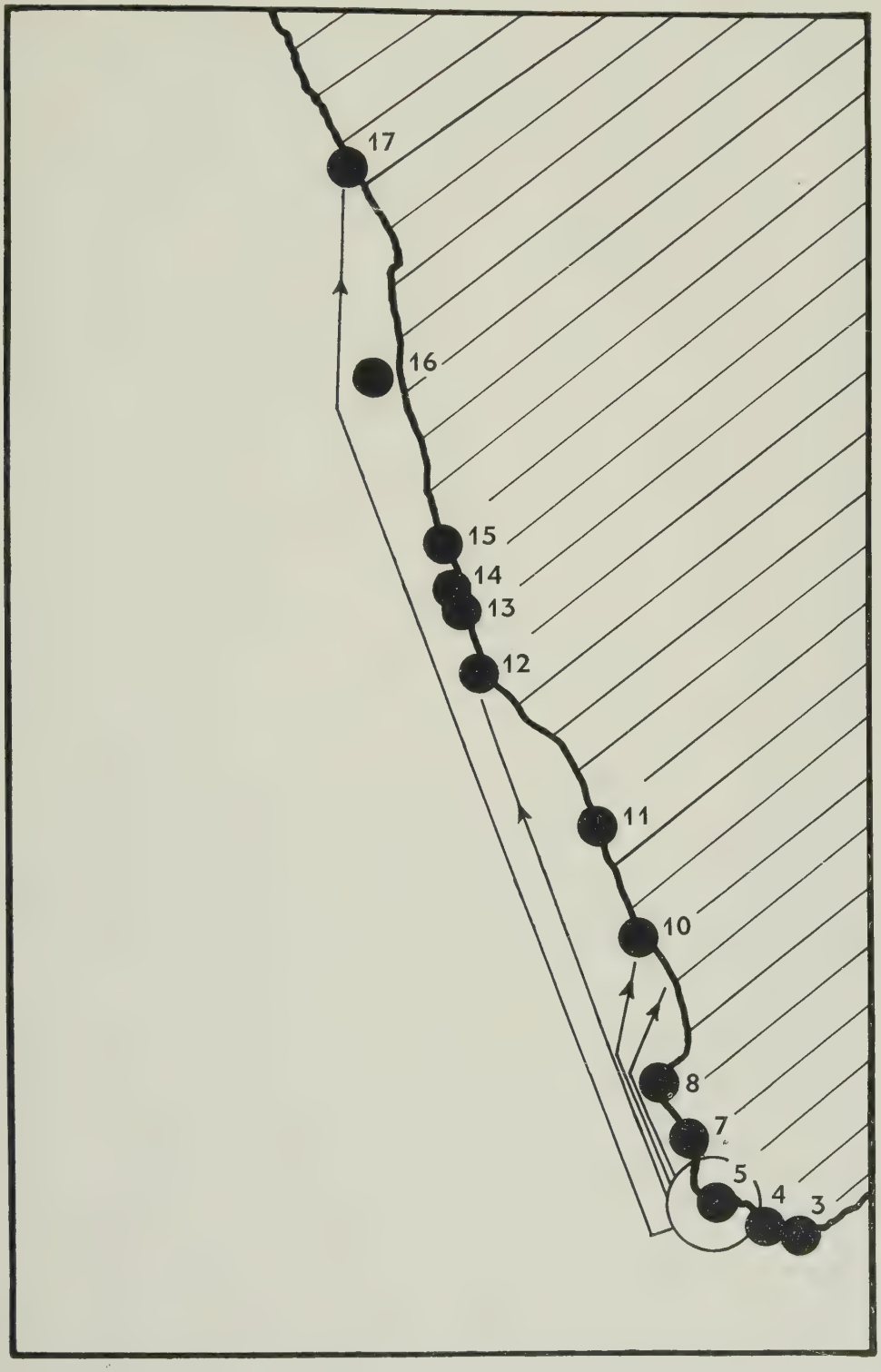


PLATE IV. RECOVERIES OF TAGGED SEALS.

PLATE V. DISTRIBUTION OF SEALS AT SEA — WEST COAST.

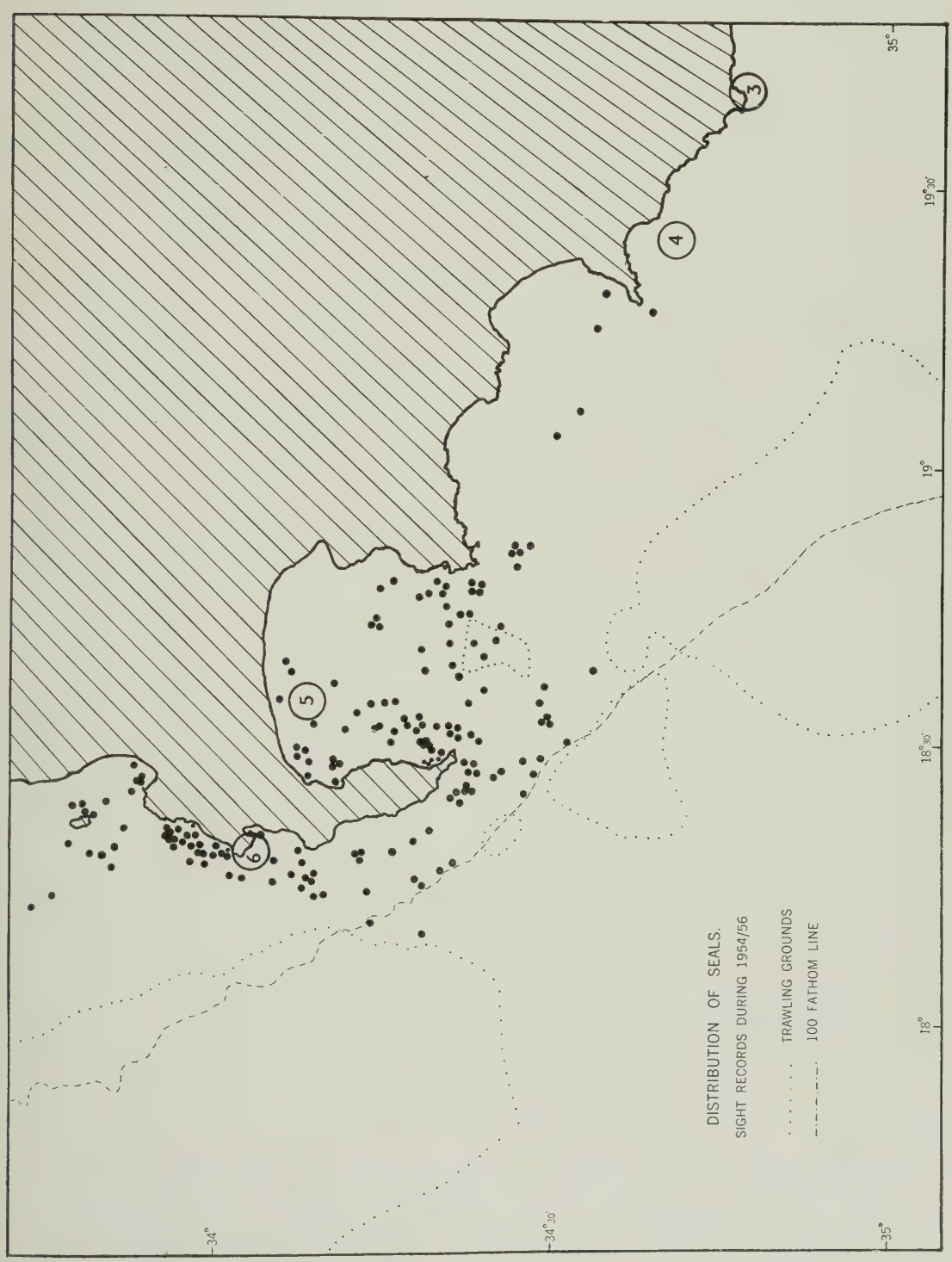
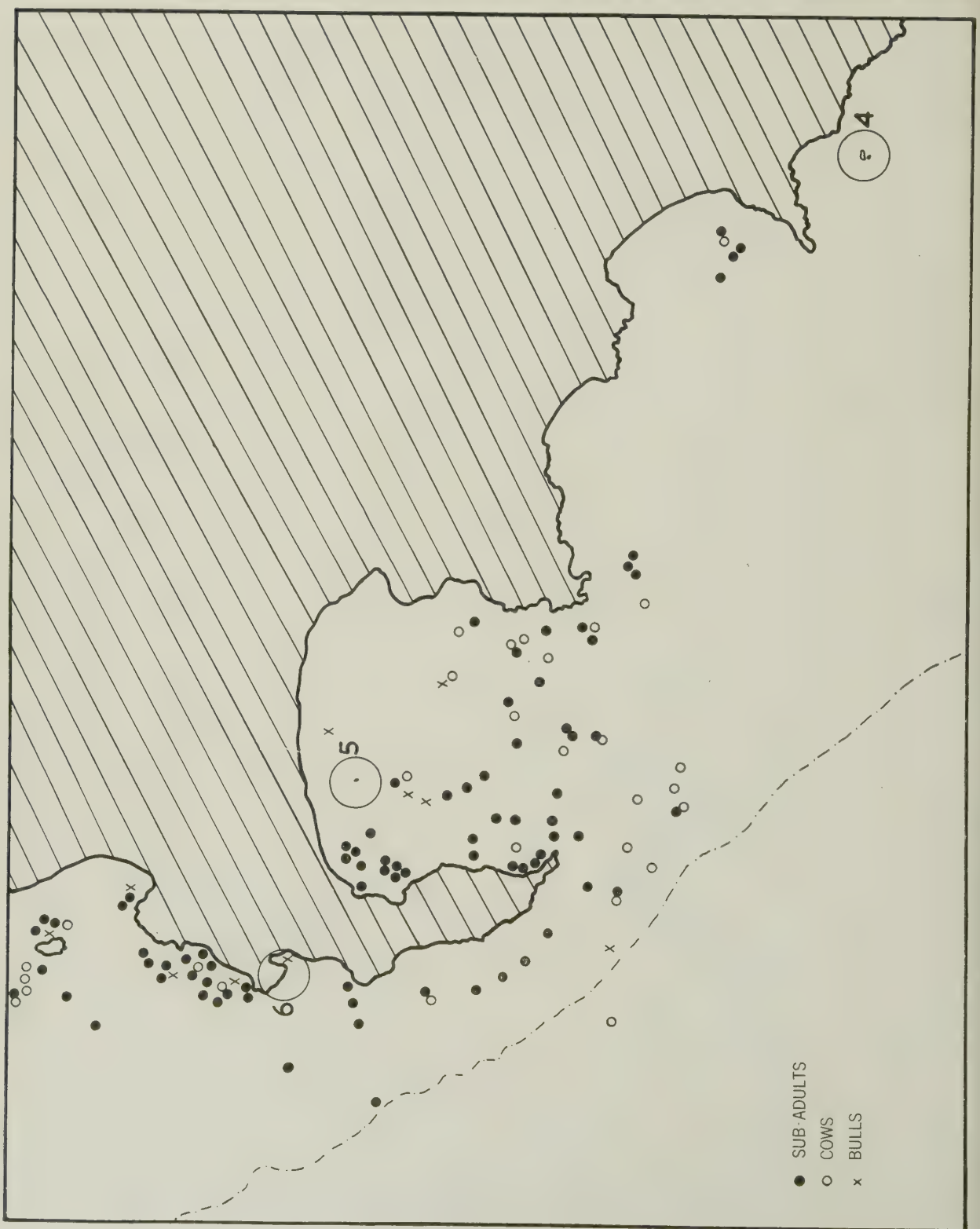


PLATE VI. DISTRIBUTION OF SEALS AT SEA—SOUTH COAST.


4
5
6
SUB-ADULTS
COWS
BULLS

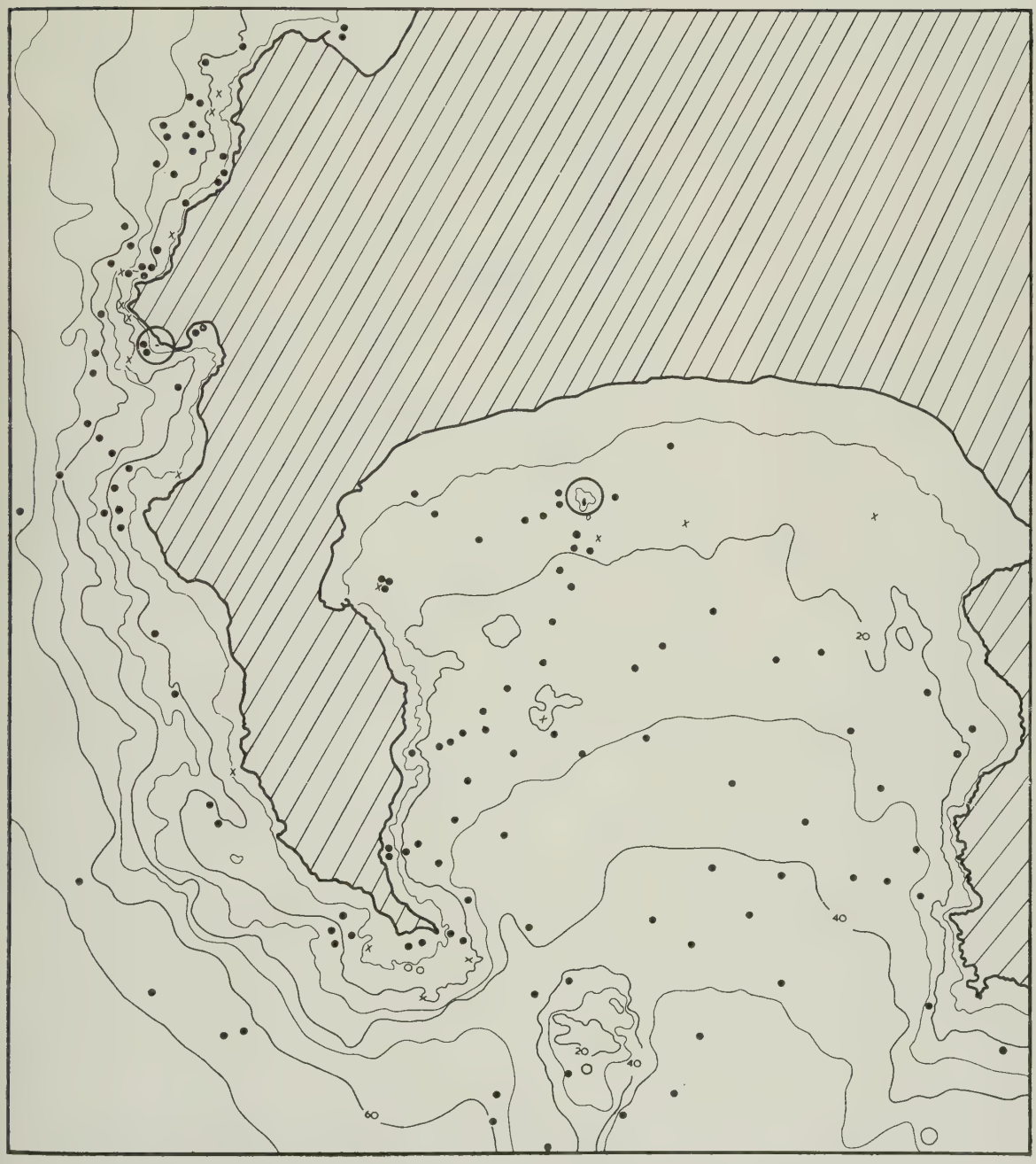


PLATE VIII DISTRIBUTION OF SEALS ACCORDING TO SEA-BOTTOM CONTOURS — SOUTH COAST.

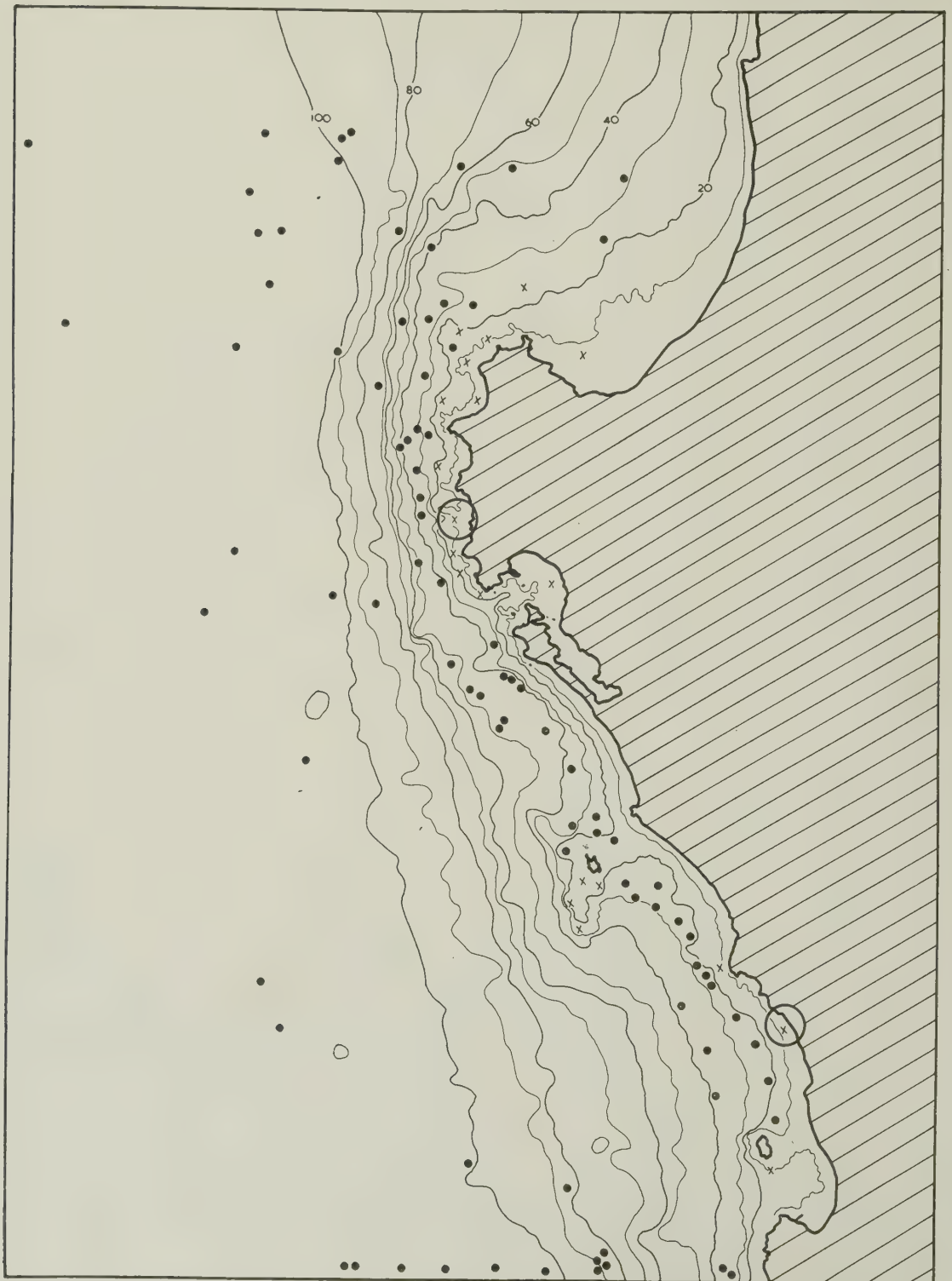


PLATE IX. DISTRIBUTION OF SEALS ACCORDING TO SEA-BOTTOM CONTOURS—WEST COAST.

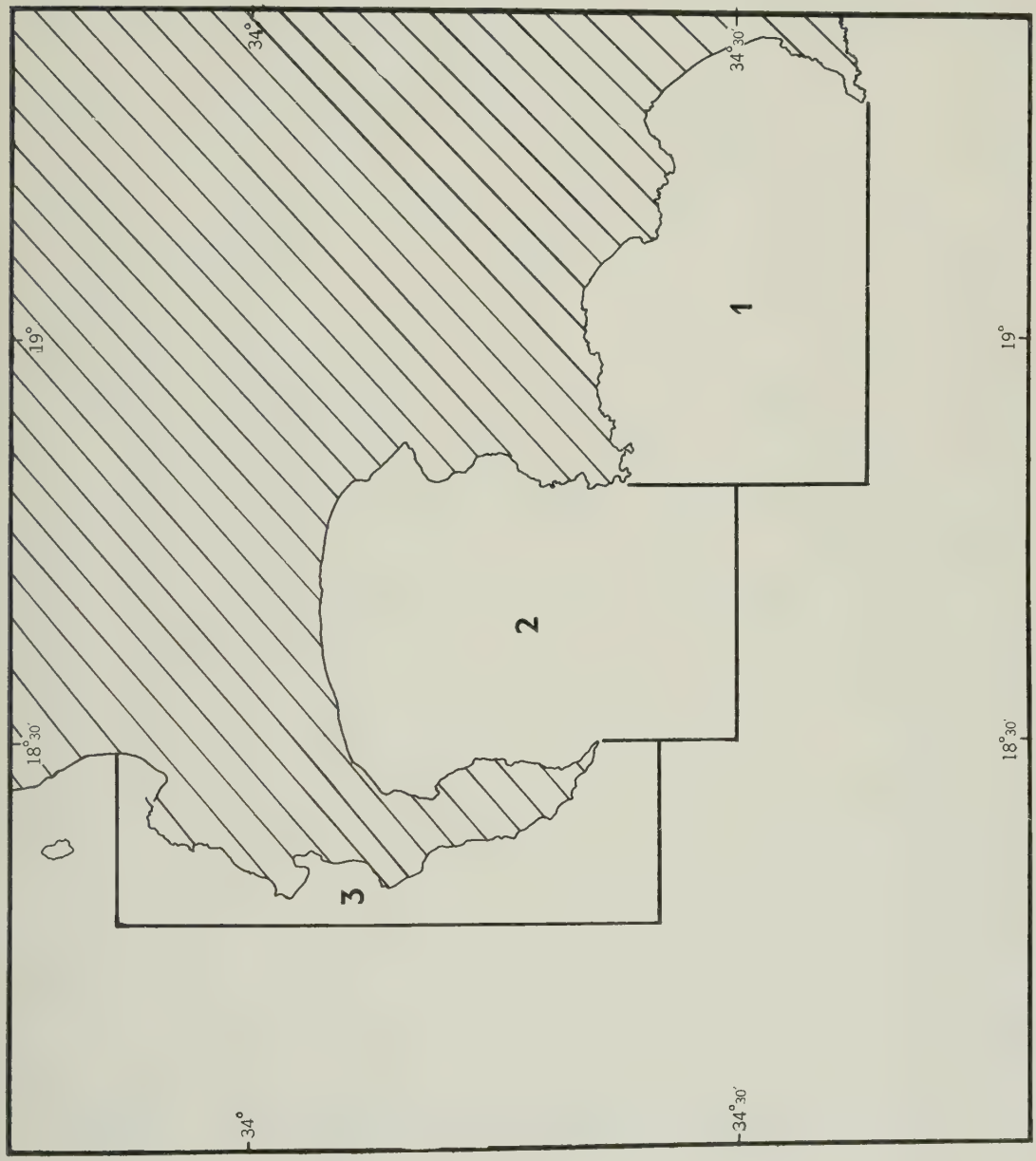


PLATE X. REFERENCE ZONES — SOUTH COAST.

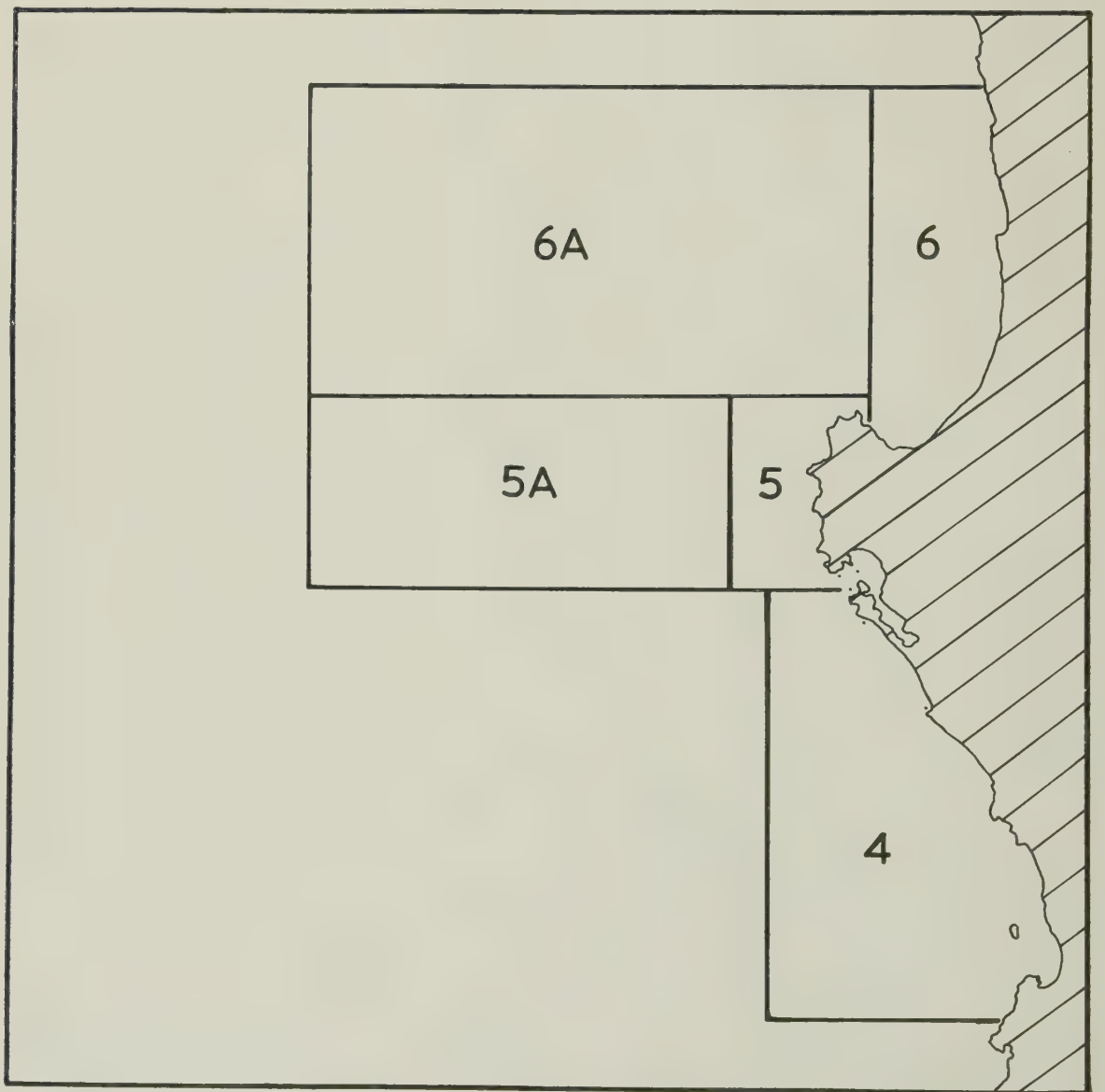


PLATE XI. REFERENCE ZONES — WEST COAST.

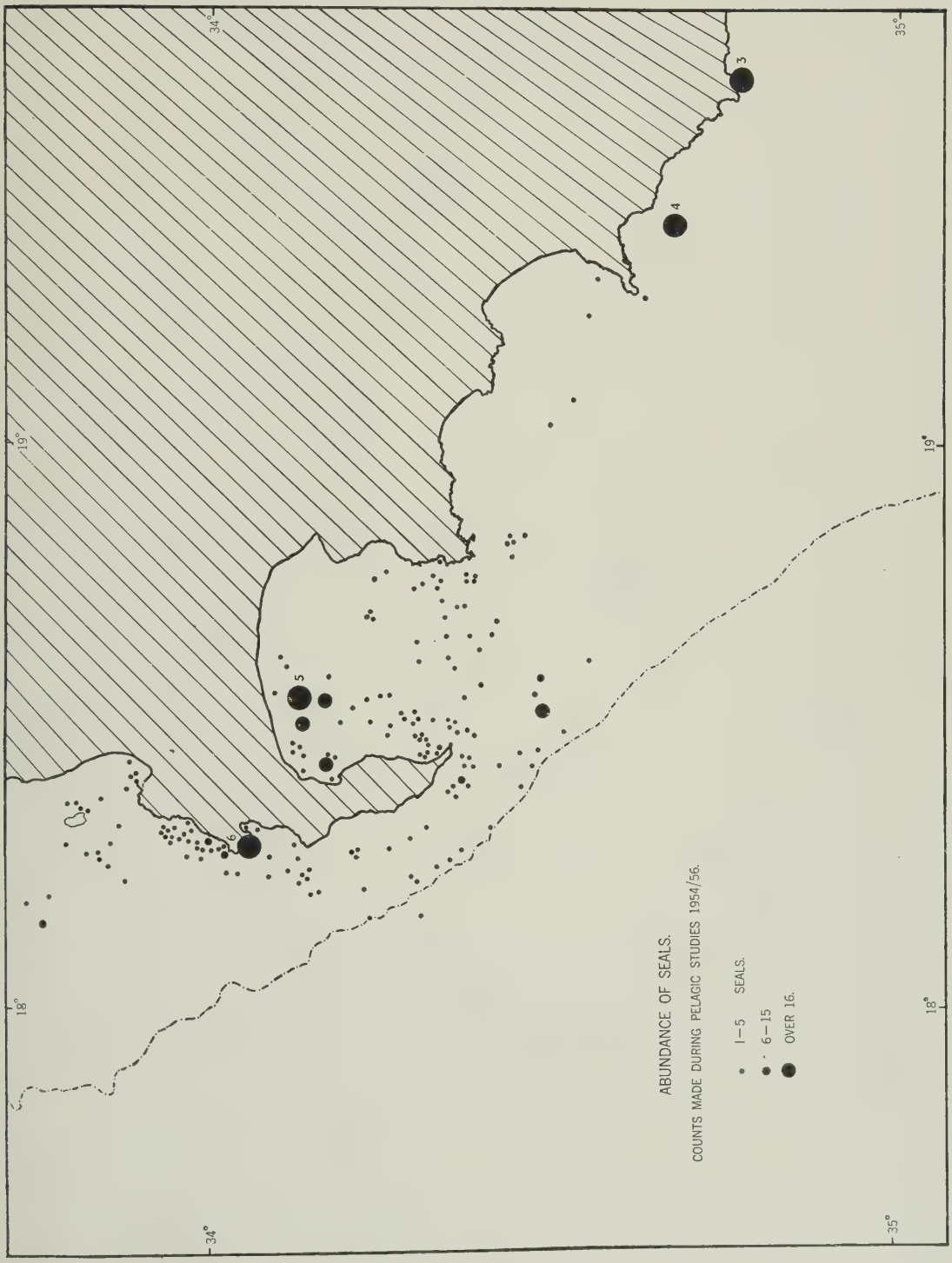


PLATE XII. ABUNDANCE OF SEALS—SOUTH COAST.

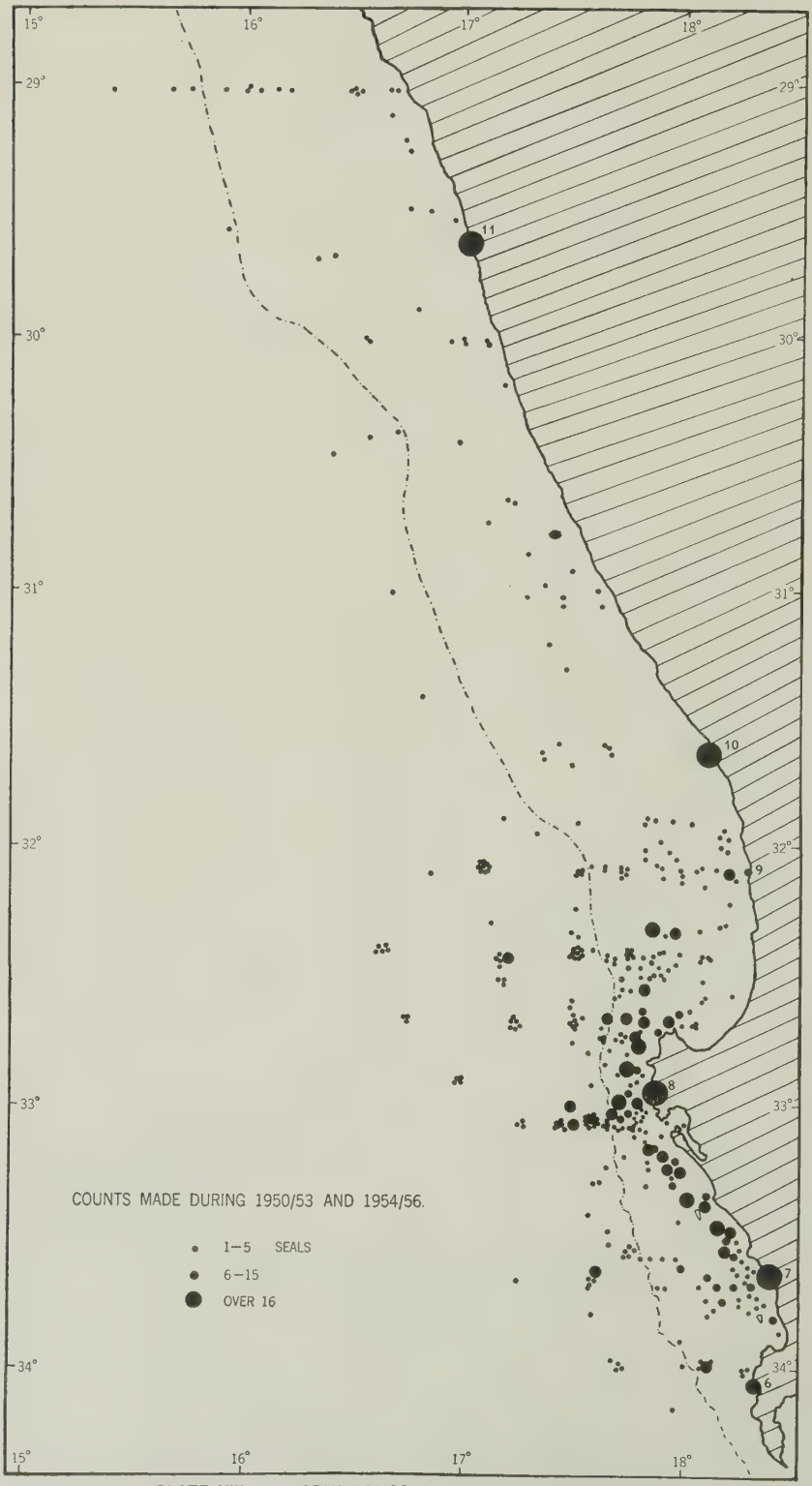


PLATE XIII. ABUNDANCE OF SEALS—WEST COAST.

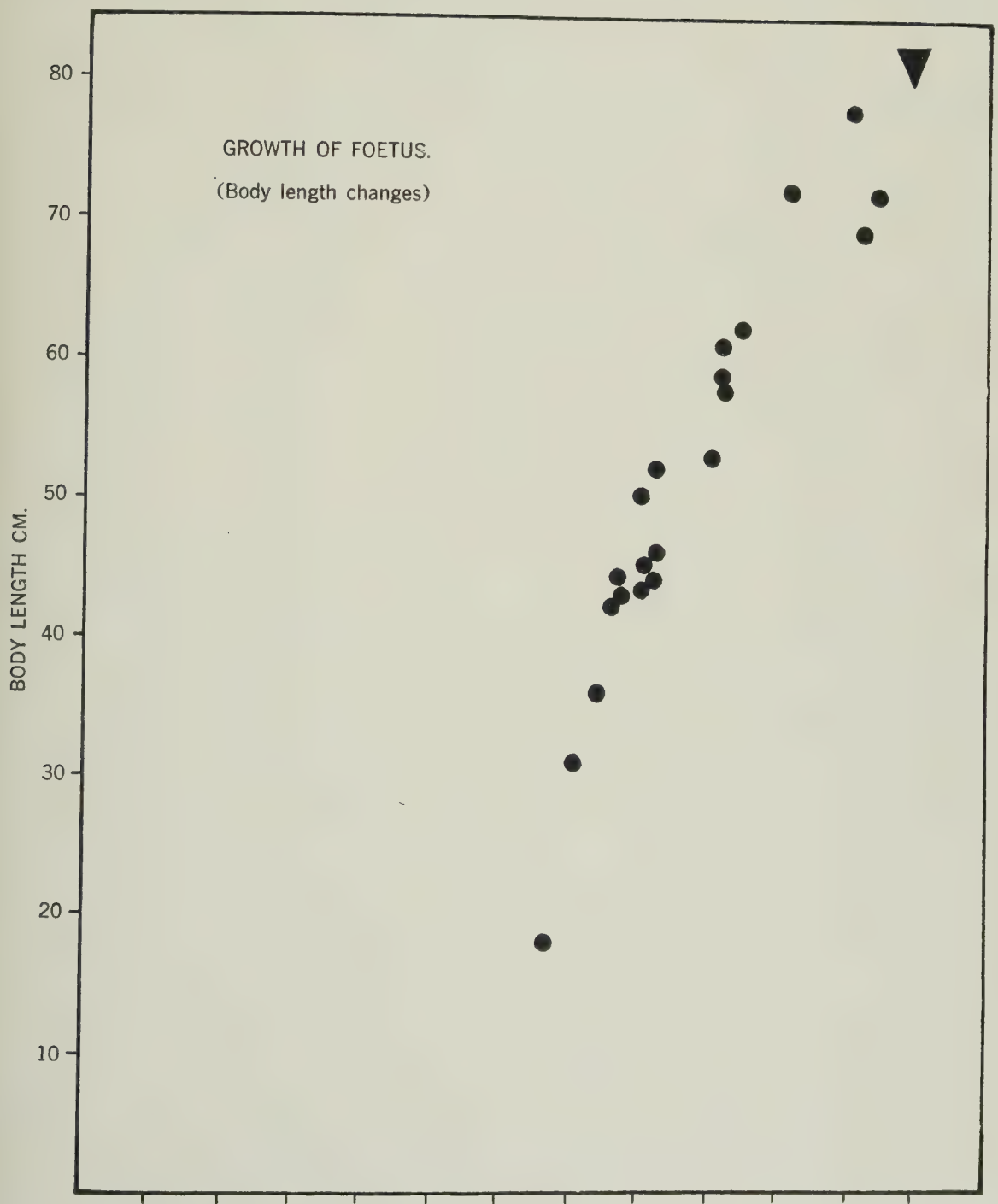


PLATE XIV. CHANGES IN FOETAL LENGTH.

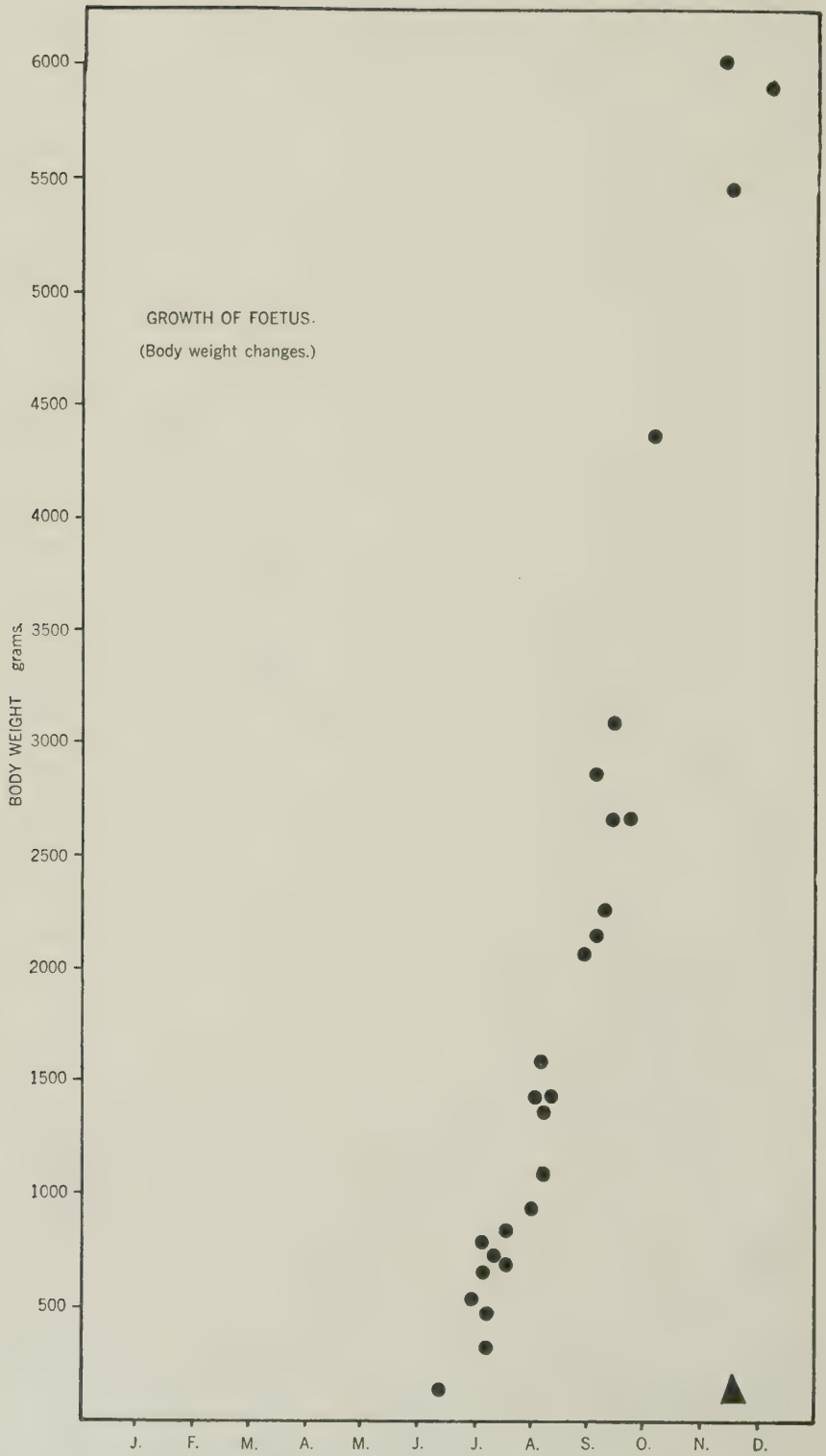


PLATE XV. CHANGES IN FOETAL WEIGHT.

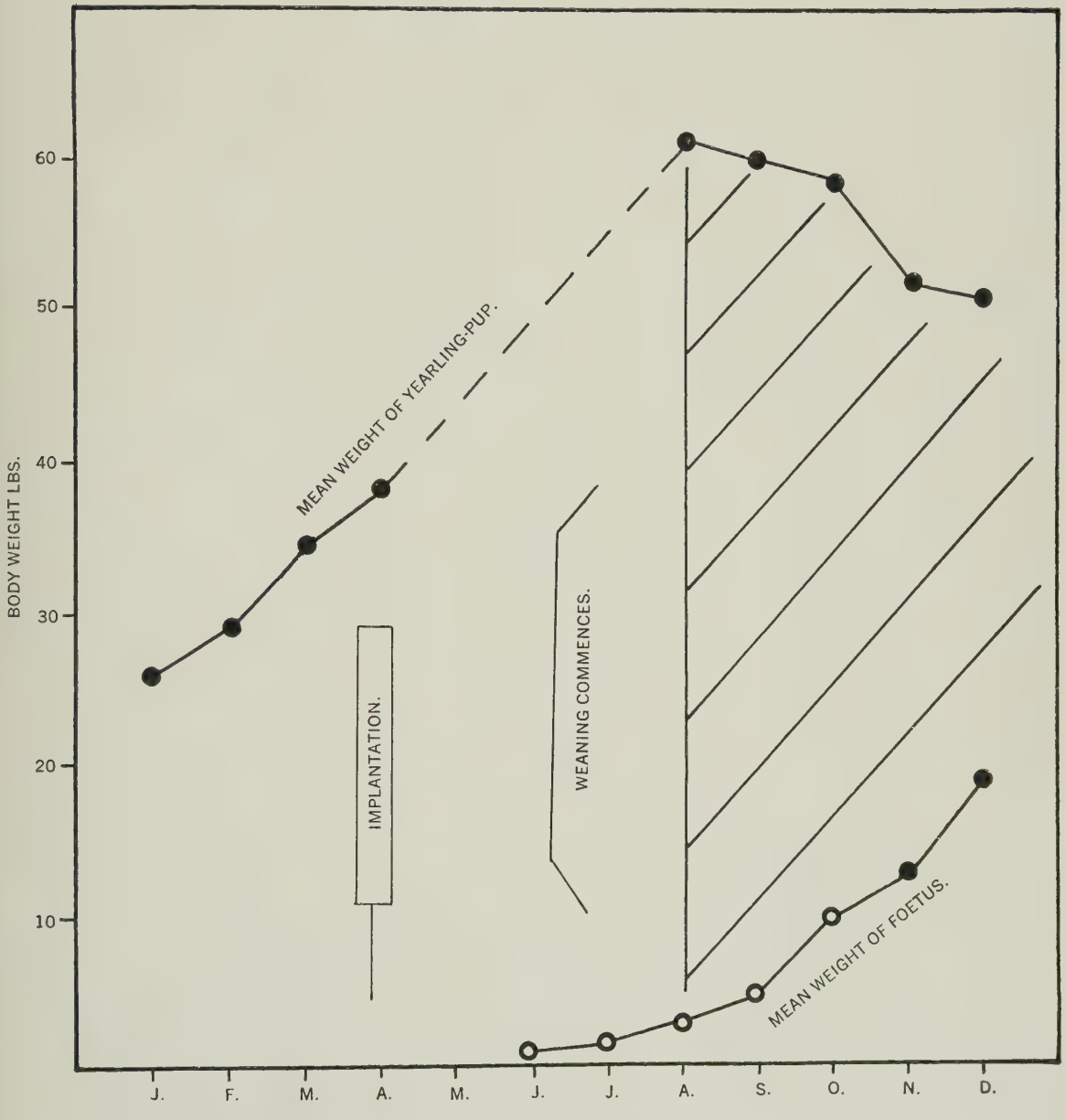


PLATE XVI. WEIGHT CHANGES IN FOETUS AND PUP.

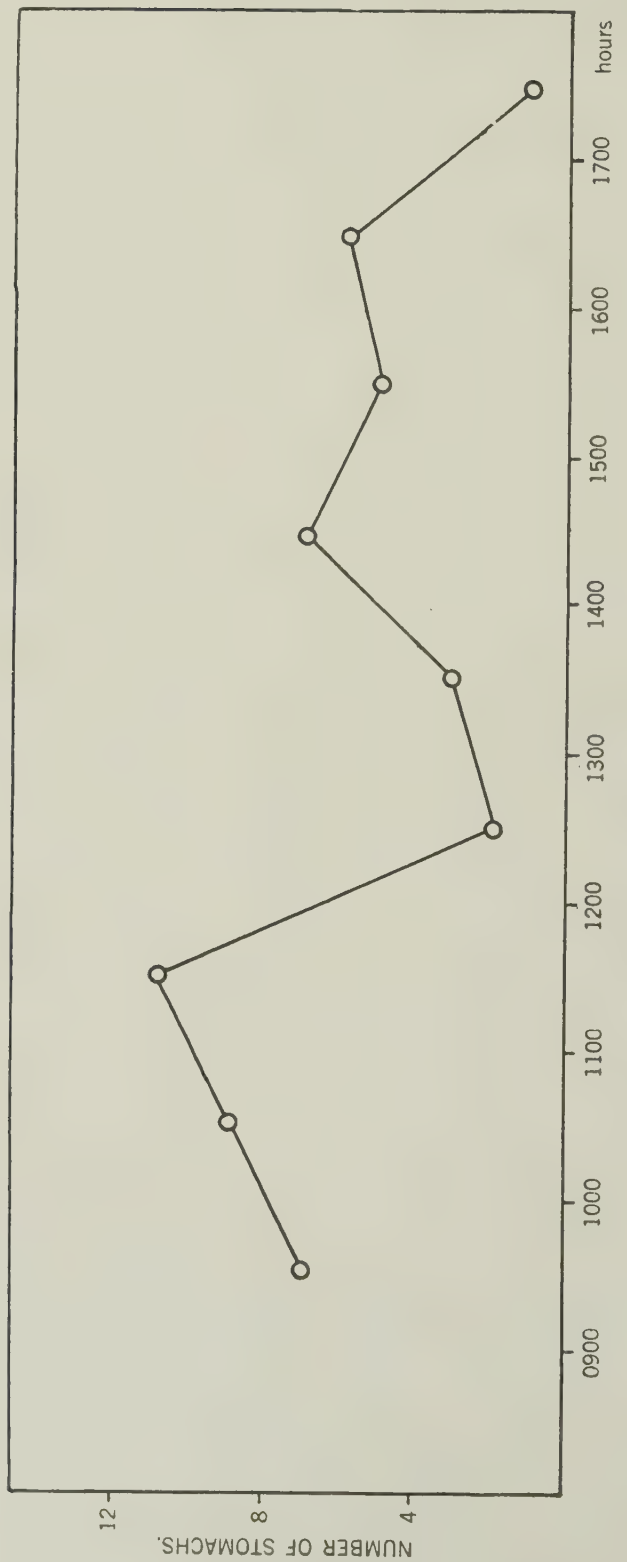


PLATE XVII FREQUENCY OF EMPTY STOMACHS DURING DAYLIGHT HOURS

PLATE XVIII. WEIGHT OF FOOD IN INDIVIDUAL STOMACHS.